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ABSTRACT

Developed through close coordination between contractors, construction workers, and vocational educators, this instructor's manual is designed to help heavy equipment instructors present materials in a systematic format. The instructional materials in the manual are written in terms of student performance, using measurable behavioral objectives. Criterion-referenced evaluation instruments provide for a uniform measurement of student progress. The manual contains four sections organized into 23 units, each consisting of eight components: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters, tests, and answers to tests and assignment sheets. Units of instruction are designed for use in more than one lesson or class period. The four sections cover hoisting equipment, earth-moving equipment, ditching and trenching equipment, and miscellaneous equipment (pumps, compressors, vibrators, paving breakers, and generators). Materials are illustrated with drawings and photographs. (KC)

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ED229544

Heavy Equipment Operator :

General Equipment Operator

instructional materials

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Associated General Contractors of America
Robert B. Fay, Chairman, Manpower and Training Committee
and
Oklahoma State Board of Vocational and Technical Education
Leslie Fisher, Chairman
Francis T. Tuttle, Director
Bob Patton, Coordinator, Curriculum and Instructional Materials Center
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HEAVY EQUIPMENT OPERATOR: GENERAL EQUIPMENT OPERATOR

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FOREWORD

Leaders in the construction industry face an endless challenge when training workers. In an effort to promote high-quality and uniform training programs in this industry, representatives of Associated General Contractors of America entered into an agreement with the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center to develop training materials. Since 1973, six AGC-CIMC manuals have been developed, distributed, and used in local chapters.

In June of 1980, work began on another new manual. The focus of this publication was to be on training the operator working in industrial and commercial construction sites. The contents of *Heavy Equipment Operator: Basic Core* and *Heavy Equipment Operator: General Equipment Operator* are the products of close coordination between contractors, construction workers, and vocational educators. Without a doubt, these manuals represent a conscious effort to meld the practical experience of the construction industry with the expertise of developers of instructional materials in the vocational education field.

The purpose of this manual is to assist heavy equipment instructors in providing a high caliber instructional program. Although the format reflects the organization of a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Heavy Equipment Operator: General Equipment Operator* should be adapted and modified to coincide with local conditions. Finally it is intended that the materials be coupled with the instructor's own methods, experience, and additional materials to make the training process complete.

Dr. Francis T. Tuttle, Director
State Department of Vocational
and Technical Education

Robert B. Fay, Chairman
Manpower and Training Committee
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PREFACE

For many years contractors and those responsible for training operators have felt the need for instructional materials to be used in training the heavy equipment operator. In 1980, the Associated General Contractors of America, with the cooperation and support of the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, accepted the challenge to produce manuals for use in training heavy equipment operators in those areas in which they are expected to be proficient.

Instructional material in this manual is written in terms of student performance, using measurable behavioral objectives. This is an innovative approach to teaching which accents and augments the teaching-learning process. Criterion-referenced evaluation instruments provide for a uniform measurement of student progress.

Equipment operator instructors are faced with the challenge of providing students with the skill and related information necessary to meet the demands of a changing profession. Competition for jobs is greater than ever. Therefore, the operator must be better trained and better equipped to find and retain meaningful employment.

The purpose of this manual is to assist equipment operator instructors in providing instruction throughout the industry. This publication should be supplemented by each instructor's methods and materials. Any information in this manual that does not concur with the instructor's course of study can very easily be modified to meet personal needs.

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Much of the work that goes into the making of a manual is not apparent when using the book. There are many people behind the scenes who make a publication possible. Special appreciation is extended to all the staff in the Word Processing Center for making sure the final typed copies are of the highest quality. The artwork in this book also deserves special commendation. Special thanks to all of you in the Art Department for the drawings you contributed to this book.

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Laborn J. "Bud" Hendrix, AGC-CIMC Writer
Curriculum and Instructional Materials Center

Suggested Activities (pink pages)

This component is included only in teacher material. The suggested activities page assists teachers during the preparation stage of the teaching-learning process by providing suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed are ones used in the development of each unit. They should be used by the teacher to supplement knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Transparency Masters (white pages in teacher material and green in student material)

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheet. They are particularly effective when identification is necessary.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience with the information. They assist students in the application of knowledges which are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided, when appropriate, and can be used by the student and/or teacher for checking student progress.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

A teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Tests (yellow pages)

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

The tests may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test--85 percent in most units--may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score along with teacher evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

These components are designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center is assigned a specific abbreviation. For example, *Heavy Equipment Operator: General Equipment Operator* has been abbreviated HEO II. The units are then numbered consecutively within each section. An example of a page number is HEO II - 1-A. Because CIMC publications are looseleaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

Material may be given out a unit or page at a time to keep the material before the students always new. Some teachers ask students to furnish a three-ring binder for the units being studied. This is more convenient for taking the materials home to study. Upon its completion each unit is placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some teachers store the materials by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

Student materials should be provided for each student for best results. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. All tests are collated at back of student material and should be removed and stored until needed. Students should be allowed to take their materials home at the end of the year.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to set up and operate a cable crane using different types of attachments. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Describe uses of cable cranes.
2. Match terms associated with cable cranes to their correct definitions.
3. Label accessories and/or attachments used on cable cranes.
4. Label basic components of a crawler cable crane.
5. Label basic components of a truck cable crane.
6. List information that the operator needs to determine capabilities of equipment quickly.
7. Select from a list items to check on daily inspection.
8. State safety factors for setting up a crane.
9. Select from a list factors to consider when determining the correct attachment for a job.
10. Select from a list procedures to perform after warm up.
11. Demonstrate the ability to
    - a. Service a crane.
    - b. Start, warm up, and check gauges and performance of controls on a crane.
    - c. Dismantle boom from crane.
    - d. Spot crane, lift, swing, and lower load.
    - e. Perform a basic job using dragline.
    - f. Perform an intermediate job using clamshell.
    - g. Perform a difficult job using pile hammer.
    - h. Remove and install counterweight from a truck crane.
    - i. Perform dragline operations in unstable soil.

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order materials planned to supplement unit.

      1. *The Weakest Link.* Color, 18 minutes, International Film Bureau, Inc., 1978. Available from International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

      2. *Craning with Confidence.* Color, 17 minutes, International Film Bureau, Inc., 1980. Available from International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

   B. Provide students with objective sheet.

   C. Provide students with information and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Stress to the students that manipulation of controls and operating procedures may differ with certain models and different manufacturers.

   H. Provide alternative jobs if job sheets are not practical.

   I. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Service a Crane

      2. Job Sheet #2--Start, Warm Up, and Check Gauges and Performance of Controls on a Crane

      3. Job Sheet #3--Dismantle Boom from Crane

      4. Job Sheet #4--Spot Crane, Lift, Swing, and Lower Load

      5. Job Sheet #5--Perform a Basic Job Using Dragline

SUGGESTED ACTIVITIES

6. Job Sheet #6–Perform an Intermediate Job Using Clamshell
7. Job Sheet #7–Perform a Difficult Job Using Pile Hammer
8. Job Sheet #8–Remove and Install Counterweight from a Truck Crane
9. Job Sheet #9–Perform Dragline Operations in Unstable Soil

E. Test

F. Answers to test

III. Unit references

A. *Department of the Army Technical Manual TM5-331B.* Washington, D.C.: Headquarters, Department of the Army, 1968.

B. Dickie, D.E. *Crane Handbook.* Toronto: Construction Safety Association of Ontario, 1975.

C. *Interservice Training Plan of Instruction: Construction Equipment.* Fort Belvoir, Virginia: United States Army Engineer School, 1975.

D. Nichols, H.L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

E. *Operating Instructions 60-XC Hydrocrane.* South Milwaukee, Wisconsin, Bucyrus-Erie Company, n.d.

F. *Special Products Manual: Link-Belt (R) Cranes, Excavators, Diesel Pile Hammers.* Cedar Rapids, Iowa: FMC Corporation, Cable Crane and Excavator Division, 1980.

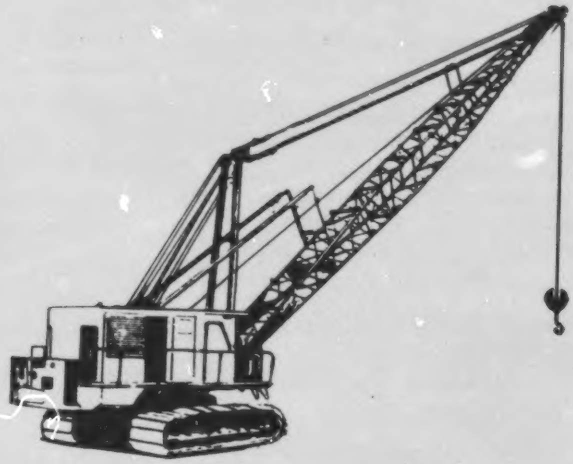
CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

INFORMATION SHEET

I. Uses of cable cranes--Basically for hoisting, but with the use of different attachments, becomes a very versatile piece of equipment (Figures 1 and 2)

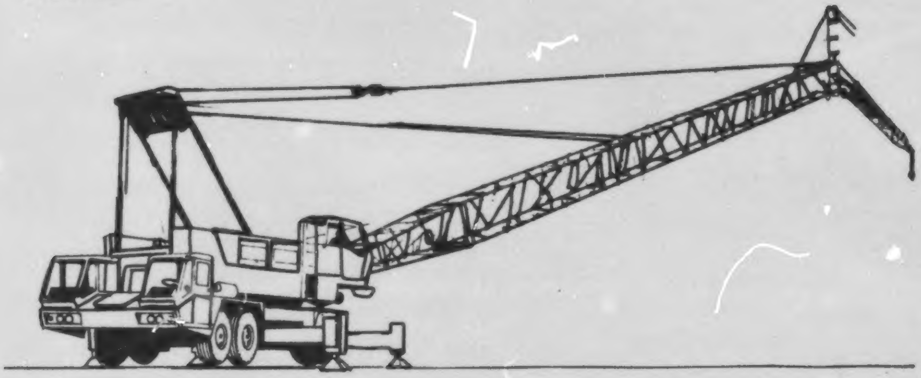
EXAMPLES:

FIGURE 1



Cable Crane (Crawler)

FIGURE 2



Cable Crane (Truck)

Used with permission of the Construction Safety Association of Ontario.

INFORMATION SHEET

II. Terms and definitions

A. Attachments--Secondary parts or assembly of parts, which add to the crane's function and usefulness

B. Dragline--Bucket attachment connected to crane by cable arrangement that provides the ability to do excavation

C. Clamshell--Type of bucket that has a set of jaws

D. Jib mast--Hinged extension on the end of a boom that is used to increase height

E. Demolition--Destroying or tearing down

F. Boom--Hinged piece on the revolving crane; used as a part of an attachment

G. Outriggers--Outward extensions of frame supported by a jack or block; used to make equipment more stable

H. Hook block assembly--Includes safety hook, bearing block, thrust bearing, brass bushing, and side weights

I. Cast--To move by throwing

J. Taut--Having no "give" or slack

K. Reeving--Threading or placing working lines

L. Lagging--Surface or contact area of a drum or flat pulley, especially a detachable surface or one of special composition

M. Gantry--An overhead structure that supports machines or operating parts

N. Pendant--Fixed boom support cable

O. Pawl (dog)--A tooth or set of teeth designed to lock against a ratchet

P. Automatic tagline--Line from a crane boom to a clamshell bucket that holds bucket and keeps it from spinning out of position

Q. Counterweight--Dead or nonworking load attached to end of machine to balance weight carried on opposite end

R. Back stays--Braces

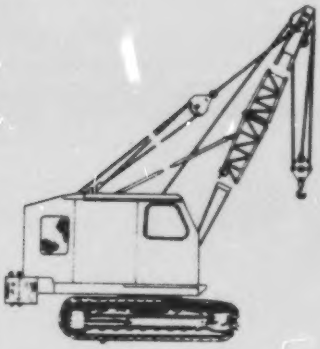
INFORMATION SHEET

III. Accessories and/or attachments used on cable cranes (Figures 3-14)

(NOTE: When changing attachments, the operator must rereeve all the cables. Therefore, the operator must be able to read, understand, and follow rereeving diagrams contained in operator's manual for the specific machine.)

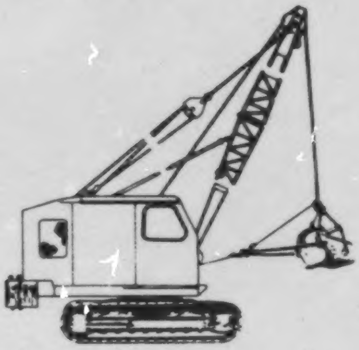
A. Crane hook (hook block)

FIGURE 3



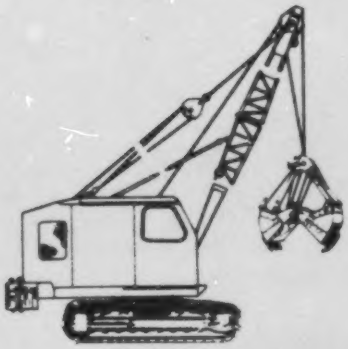
B. Dragline

FIGURE 4



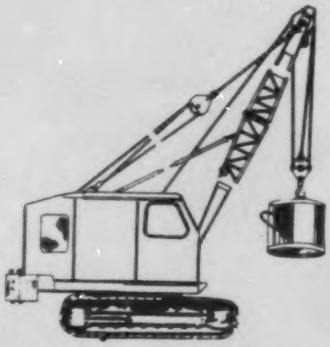
C. Clamshell

FIGURE 5



D. Concrete bucket

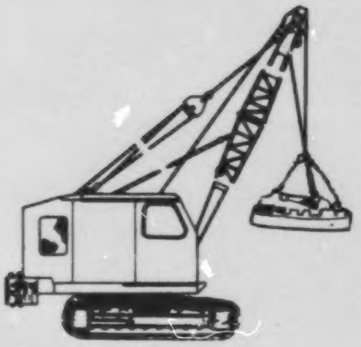
FIGURE 6



INFORMATION SHEET

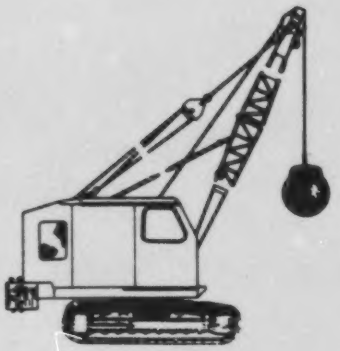
E. Magnet

FIGURE 7



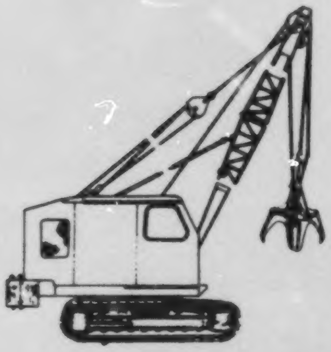
F. Demolition (breaker ball)

FIGURE 8



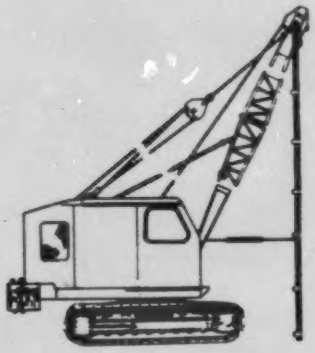
G. Tong grapple

FIGURE 9



H. Pile hammer

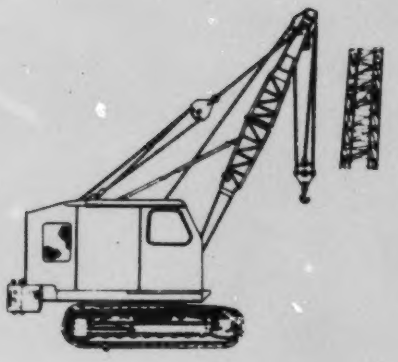
FIGURE 10



INFORMATION SHEET

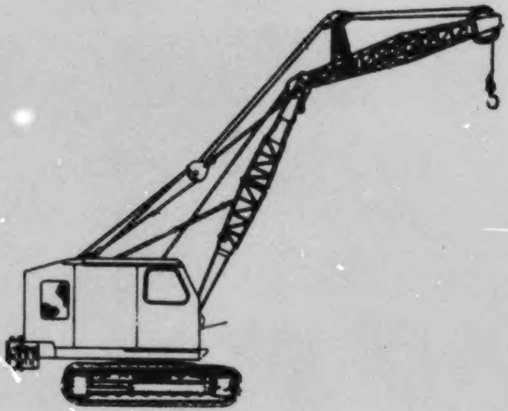
I. Boom extension

FIGURE 11



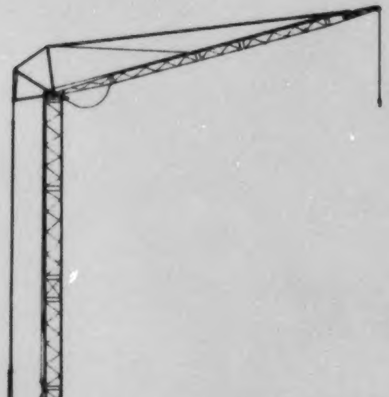
J. Jib boom (jib mast)

FIGURE 12



K. Tower attachment

FIGURE 13



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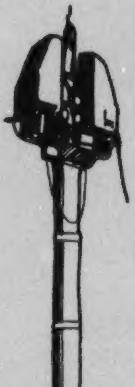
L. Vibratory probe

FIGURE 14

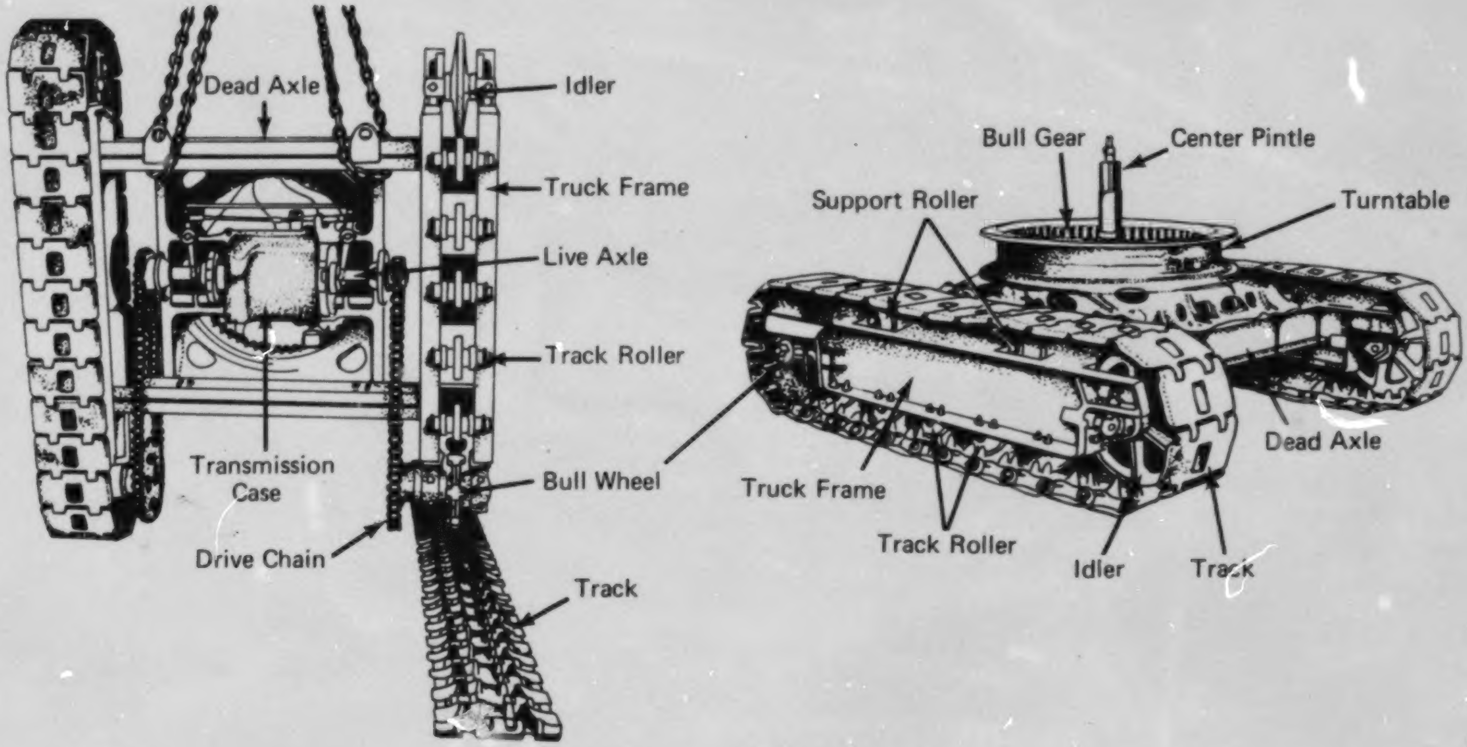


Used with permission of the L.B. Foster Company.

INFORMATION SHEET

IV. Basic components of a crawler cable crane (Figure 15)

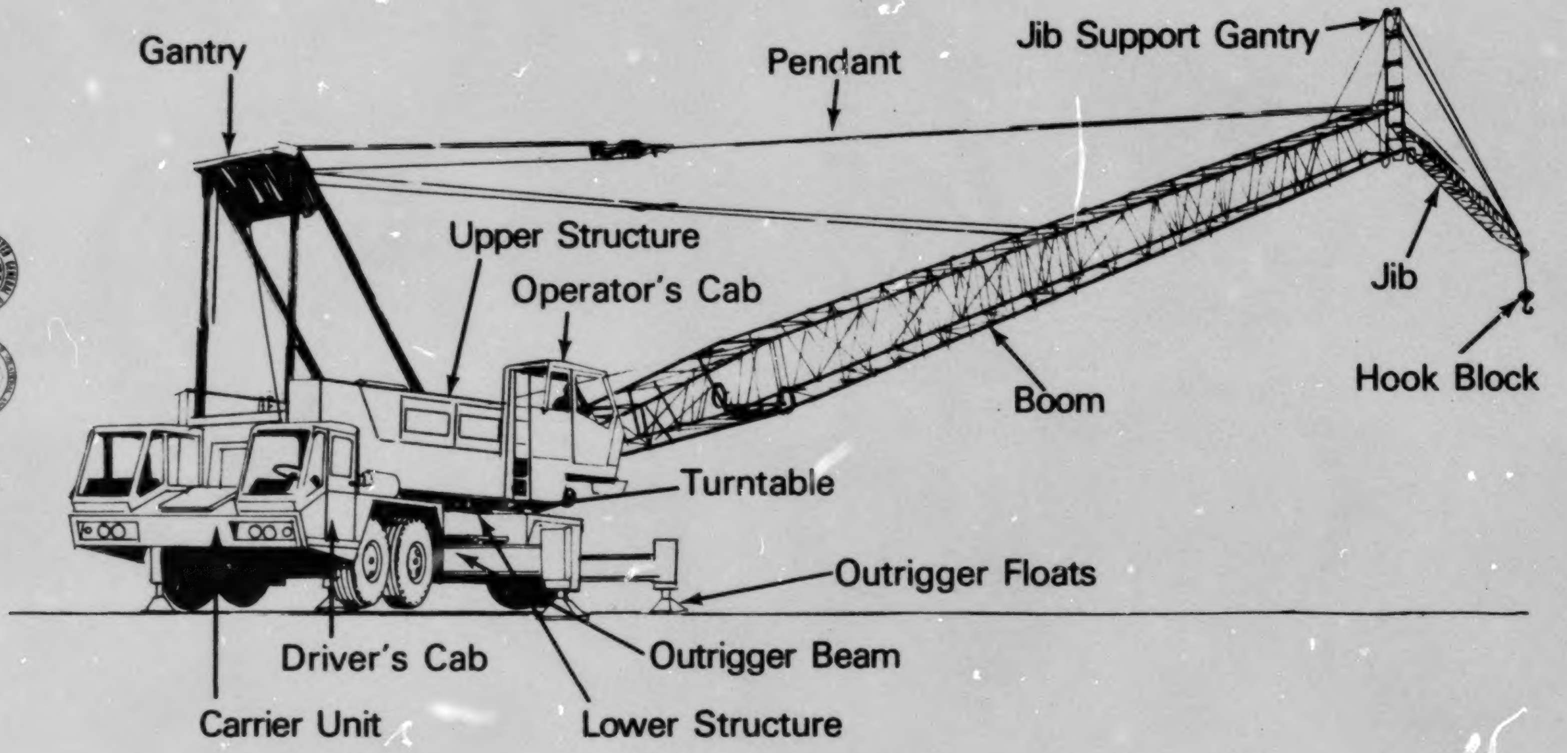
FIGURE 15


Dead Axle
Idler
Truck Frame
Live Axle
Track Roller
Transmission Case
Bull Wheel
Drive Chain
Track
Bull Gear
Center Pintle
Support Roller
Turntable
Dead Axle
Truck Frame
Track Roller
Idler
Track

INFORMATION SHEET

V. Basic components of a truck cable crane (Figure 16)

FIGURE 16


Gantry
Pendant
Jib Support Gantry
Upper Structure
Operator's Cab
Jib
Hook Block
Boom
Turntable
Outrigger Floats
Driver's Cab
Outrigger Beam
Carrier Unit
Lower Structure

Used with permission of the Construction Safety Association of Ontario.

INFORMATION SHEET

VI. Information that the operator needs to determine capabilities of equipment quickly

(NOTE: This information is found on a plate inside the cab.)

- A. Crane model number, serial number, and date of manufacture
- B. Load ratings for main boom at all stated radii
- C. Boom angles
- D. Boom lengths
- E. Boom types
- F. Method of determining boom jib combination ratings
- G. Jib ratings (load and angle)
- H. Work areas for which capacities are listed in chart

VII. Items to check on daily inspection

- A. Possible broken or missing parts; leaks, switches, and controls
- B. Tires and tire pressure
- C. Engine oil level
- D. Transmission fluid level
- E. Battery electrolyte level
- F. Hydraulic system
- G. Brakes
- H. Air cleaner indicator
- I. Cooling system
- J. Fuel system and supply
- K. Hydraulic fluid level on sight glass
- L. Wire connections and insulation
- M. Components of lower travel assembly
- N. Components of upper revolving frame
- O. Cables, drum assemblies, and attachments
- P. Pawl (dog); engage or disengage according to job requirements
- Q. Cab cleanliness

INFORMATION SHEET

VIII. Safety factors for setting up a crane

- A. Consider your own safety and that of the public, all personnel, and property
- B. Consider job site accessibility and safeness
- C. Determine whether equipment will have to travel over ditches where pipe may be damaged
- D. Allow sufficient room for erection and maneuverability
- E. Ensure ample storage room for booms and components without interfering with maneuvers
- F. Know the crane's maximum operating radius

  (NOTE: There should be at least two feet clearance between counterweight and obstacles.)
- G. Determine that the operating location is level and solid
- H. Know what excavations, slopes, trenches, or embankments are near the location
- I. Make sure that your view of other equipment is clear
- J. Know the location of power lines within the work area

  (CAUTION: If operating near power lines, power should be shut off, or lines should be insulated.)

IX. Factors to consider when determining the correct attachment for a job

- A. Site conditions
- B. Type of job
- C. Weights and dimensions of heaviest and largest loads
- D. Lift radius
- E. Height of lift

X. Procedures to perform after warm up

- A. Check gauges for proper pressures and temperature
- B. Operate controls that move crane forward and backward
- C. Operate controls to turn and swing boom
- D. Operate controls to raise and lower boom

INFORMATION SHEET

E. Operate controls to raise and lower load

F. Check cable conditions for kinks or frays and loose connections

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #1--SERVICE A CRANE

I. Equipment and materials

  A. Crane and attachment

  B. Tool kit

  C. Grease gun

  D. Air supply

  E. Lubricants

  F. Cleaning solvents

  G. Rags

  H. Water

  I. Engine coolant

  J. Fuel

  K. Tire pressure gauge

  L. Brake fluid

II. Procedure

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

  A. Visually inspect for leaks and broken, worn, or missing parts

  (NOTE: Items found damaged, worn, or missing should be reported and repaired.)

  B. Check engine oil level, filter, lines, and hoses; add engine oil if necessary

  C. Check air cleaner filter (element); clean or replace if necessary

  D. Check engine coolant level, radiator cap, hose, and radiator; add coolant if necessary

  (CAUTION: Do not remove radiator cap unless engine is cool; then, open cap slowly to release pressure.)

JOB SHEET #1

E. Check fuel level, fuel filters, and sediment bowl (where applicable); fill fuel tank

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if necessary

(NOTE: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, and fittings and look for leaks; add fluid if required

I. Check transmission fluid level; add fluid if necessary

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; fill if necessary

M. Check cl[illegible] adjustment; adjust when necessary

N. Check drive belts for tension and wear; adjust or replace if necessary

O. Check wiring, insulation, and connections

P. Clean and lubricate grease fittings

Q. Check tires or tracks

R. Check all safety devices; repair if necessary

S. Check windshield and windshield wipers; clean if necessary

T. Check major components and/or accessories

U. Check gauges and controls to be sure they are functioning properly

V. Lubricate steering cylinder bearings

W. Check components of upper frame

X. Check components of lower frame (tractor-type)

Y. Check booms and attachments

Z. Check all drums and cables; lubricate if necessary

AA. Clean dirt from tracks (tractor-type)

BB. Check hook block assembly

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #2--START, WARM UP, AND CHECK GAUGES AND PERFORMANCE OF CONTROLS ON A CRANE

I. Equipment--Crane

II. Procedure

A. Push engine clutch lever forward to disengage clutch

B. Advance hand throttle lever halfway

C. Use choke as required (if applicable)

D. Turn ignition switch on

E. Depress starter button

F. Release starter button when engine starts

(CAUTION: Do not crank engine more than 30 seconds without a two-minute cooling period. If engine fails to start after a few tries, determine cause and correct before trying again.)

G. Pull out throttle control to maintain fast idle speed

H. Open choke

I. Check for abnormal noise or operation

J. Check for correct temperature on temperature gauge

K. Check for correct operating engine oil pressure

L. Check for plus reading on voltmeter

M. Check tachometer for correct rpm (revolutions per minute) reading

N. Check front and rear clutch

O. Check boom hoist clutch

P. Check front and rear drum brake

Q. Check boom hoist brake

R. Check for proper operation of all controls

S. Engage or disengage pawl (dog) according to job requirements

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #3--DISMANTLE BOOM FROM CRANE

I. Equipment and materials

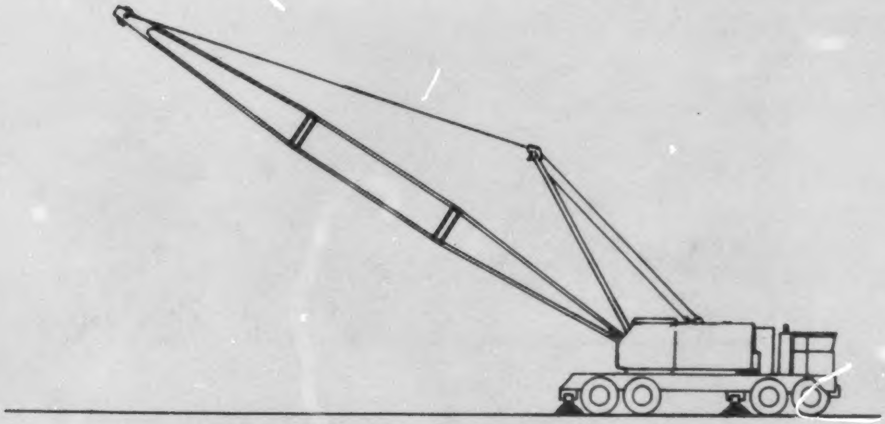
- A. Crane
- B. Blocking (for outriggers)
- C. Blocking (for boom)
- D. Sledge hammer
- E. Drift pin
- F. Tool kit
- G. Gloves

II. Procedure

(NOTE: These steps should be followed unless others are specified by manufacturer.)

- A. Move crane to a level area
- B. Set outriggers and level machine (Figure 17)

FIGURE 17



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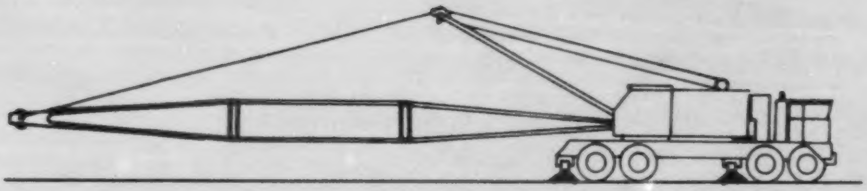
JOB SHEET #3

C. Check to see that counterweight is correct

D. Set swing lock

E. Lower boom over rear of carrier until almost level (Figure 18)

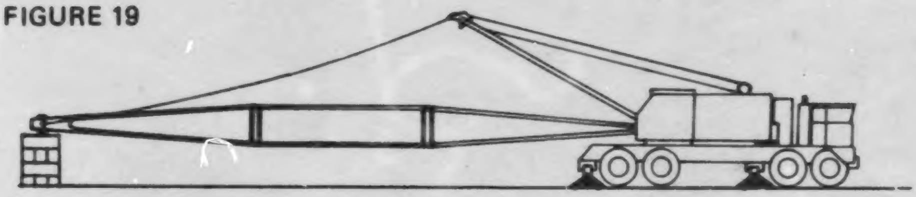
FIGURE 18



Used with permission of the Construction Safety Association of Ontario.

F. Place blocking under boom tip and lower boom onto blocking until pendants are slack (Figure 19)

FIGURE 19

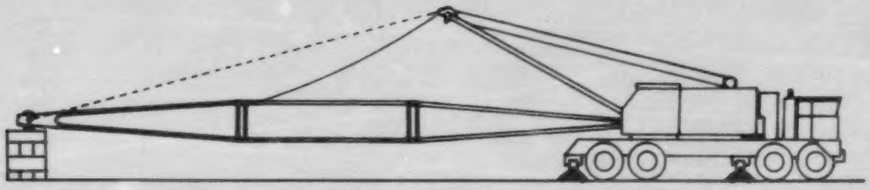


Used with permission of the Construction Safety Association of Ontario.

JOB SHEET #3

G. Move pendants back and re-anchor to a lower boom section (Figure 20)

FIGURE 20



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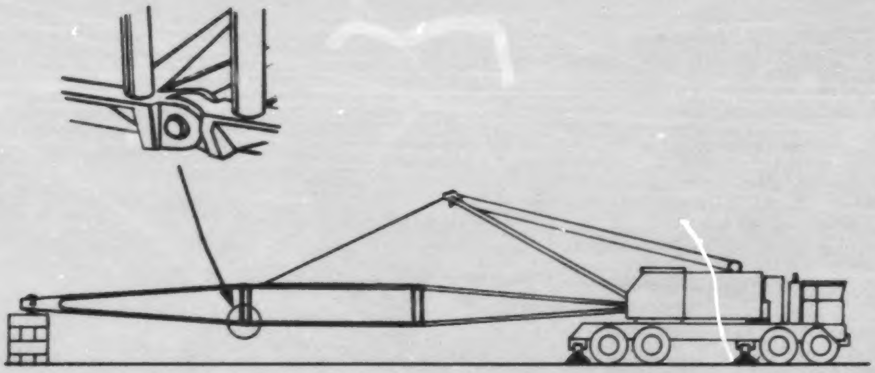
H. Elevate boom slightly to put strain on pendants but not enough to lift boom off of blocking

I. Drive out lower pins on section ahead of pendants (Figure 21)

FIGURE 21

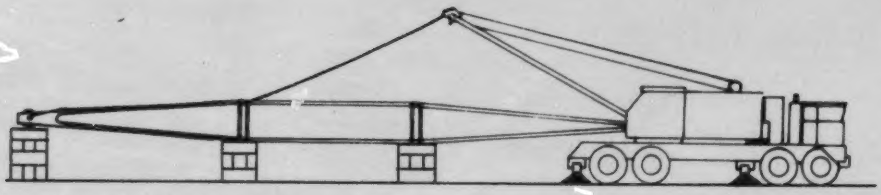


Used with permission of the Construction Safety Association of Ontario.

JOB SHEET #3

J. Place blocking under each section; then lower boom back down (Figure 22)

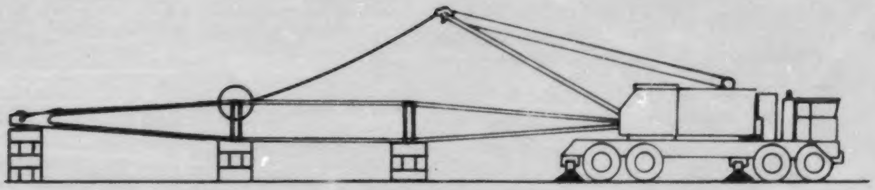
FIGURE 22



Used with permission of the Construction Safety Association of Ontario.

K. Drive out upper pins on section to be removed (Figure 23)

FIGURE 23



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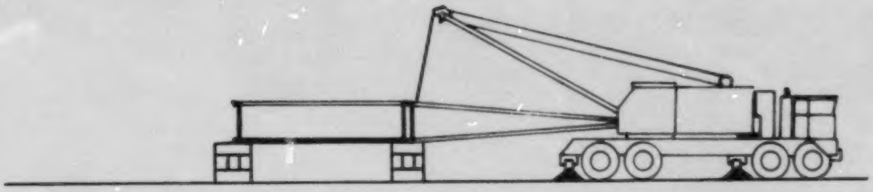
JOB SHEET #3

L. Remove first section and repeat previous steps until boom is completely dismantled (Figure 24)

FIGURE 24



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CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #4--SPOT CRANE, LIFT, SWING, AND LOWER LOAD

I. Equipment and materials

   A. Crane

   B. Load

II. Procedure

   A. Spot crane

      1. Move crane to load
      2. Position crane so that most of the work will be performed over the rear
      3. Set crane brakes (block wheels if truck-mounted)
      4. Extend and set outriggers

   B. Lift load

      1. Engage boom hoist clutch lever
      2. Engage boom hoist lever to raise or lower until boom is centered over load
      3. Determine load level
      4. Move lever to neutral

         (NOTE: Boom hoist brake will hold boom in this position.)

      5. Attach hook block to load
      6. Release left drum brake while engaging hoist drum lever
      7. Hoist to desired height
      8. Apply brake and move lever to neutral
      9. Lock brake to prevent load from falling

         (NOTE: Never get out of crane with brake locked in position with a line load.)

JOB SHEET #4

C. Swing load

(NOTE: Keep left hoist drum brake on while swinging.)

1. Engage swing clutch lever to swing to right

   (NOTE: Engage slowly so that swing will be smooth.)

2. Engage lever gently in opposite swing position to stop swing

   (CAUTION: Never stop swing with swing brake.)

   (NOTE: Swinging and hoisting can be done simultaneously.)

3. Engage swing lock lever to keep cab from drifting

D. Spot and lower load

1. Be sure swing lock and hoist brakes are engaged

2. Raise or lower boom with boom hoist lever as necessary to make accurate placement of load

3. Release left hoist drum brake, and control lowering of free falling load with brake and left hoist drum lever

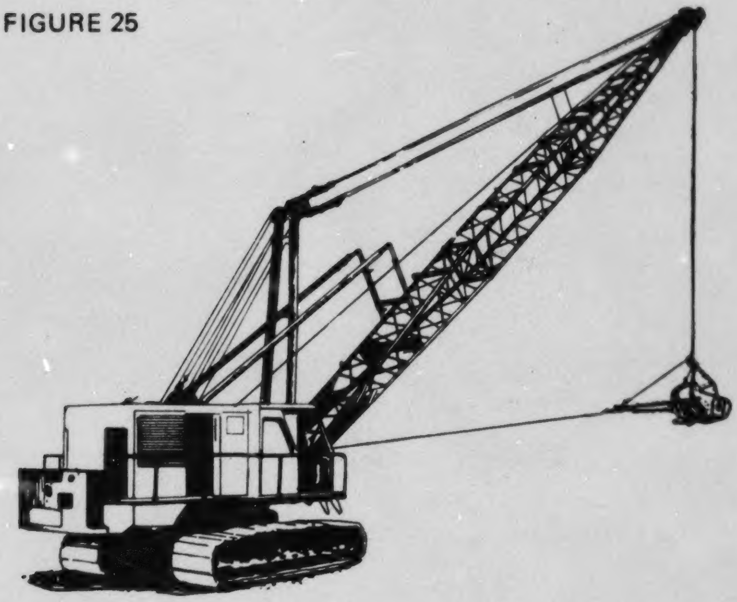
   (CAUTION: Heavy loads should be moved more slowly by using power-down device; this will lower load under power.)

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #5--PERFORM A BASIC JOB USING DRAGLINE

I. Equipment--Crane with dragline attachment (Figure 25)

FIGURE 25



II. Procedure

A. Spot crane

1. Move crane to position
2. Position crane so that most of the work will be performed over the rear
3. Set crane brakes and block wheels
4. Extend and set outriggers
5. Release manual pawl (dog)

B. Set boom at proper angle

1. Engage boom hoist clutch lever
2. Engage boom hoist lever to raise or lower until boom indicator is at desired angle (30 to 78 degrees)
3. Move lever to neutral

(NOTE: Boom hoist brake will hold boom in this position.)

JOB SHEET #5

C. Cast and fill bucket

1. Engage holding hoist drum lever and raise bucket half the distance between ground and boom point

2. Depress hoist drum brake and return lever to neutral

3. Engage drag drum lever and pull bucket in toward the boom

4. Release lever and brake pedal at the same time, allowing bucket to cast out beyond the boom point

   (NOTE: Reengage brake lightly to keep cable from running off drum.)

5. Engage drag drum lever, dragging bucket toward the crane

6. Ease up on hoist drum brake pedal, allowing hoist cable to reel off the drum so that bucket teeth continuously bite into the ground

7. Release drag drum lever and depress both brake pedals when bucket is full

D. Raise the bucket

1. Engage hoist drum lever and release hoist drum brake pedal

2. Ease up on drag drum brake pedal to hold bucket level and prevent dumping as bucket is raised to desired height

3. Apply hoist drum brake and release hoist drum lever; apply drag drum brake

E. Swing bucket

(NOTE: Keep both drag and hoist drum brakes on while swinging.)

1. Engage swing clutch lever to swing right or left toward dump pile

   (NOTE: Engage slowly so that swing will be smooth.)

2. Engage lever in opposite swing position to stop swing

F. Dump load

1. Release drag drum brake pedal (as dump pile is approached), allowing the bucket to swing out and dump its load

2. Apply drag drum brake (when bucket is dumped) to keep cable taut and prevent unwinding

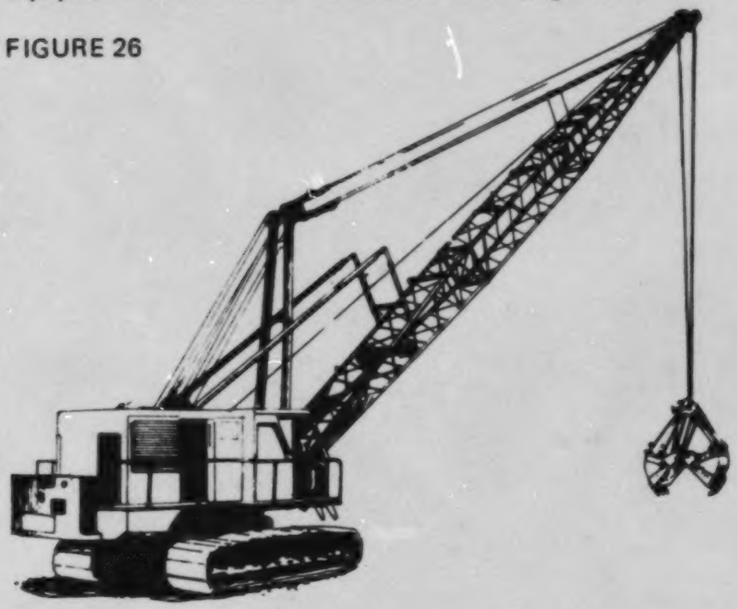
3. Swing boom back; cast dragline bucket and repeat cycle

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #6--PERFORM AN INTERMEDIATE JOB USING CLAMSHELL

I. Equipment--Crane with clamshell attachment (Figure 26)

FIGURE 26



II. Procedure

A. Spot crane

1. Move crane to position
2. Set crane brakes and block wheels
3. Extend and set outriggers
4. Check automatic tagline for proper operation

B. Set boom at proper angle

1. Engage boom hoist clutch lever
2. Engage boom hoist lever to raise or lower until boom is in approximate position
3. Move lever to neutral

(NOTE: Boom hoist brake will hold boom in this position.)

JOB SHEET #6

C. Fill clamshell

1. Lower opened clamshell until it is about one foot above material to be worked

2. Apply both brake pedals

3. Release both brake pedals at the same time and drop clamshell

4. Close clamshell by engaging closing line drum lever; at the same time, control digging depth with holding drum lever until clamshell is closed and loaded

   (NOTE: To decrease depth, engage holding drum lever; this will raise bucket and decrease the bite.)

D. Raise load

1. Keep closing line drum lever engaged

2. Engage holding drum lever so that cable is taken up at the same rate and the bucket is raised to desired height

   (NOTE: Never allow closing cable to go slack, or clamshell will immediately swing open.)

3. Apply both closing line and holding line brake pedals; at the same time, release both the closing line and holding line drum levers

   (NOTE: Keep both closing line and holding line drum brakes on while swinging.)

4. Engage swing clutch lever to swing to right or left as desired

   (NOTE: Engage levers slowly so that swing is smooth.)

5. Gently engage lever in opposite swing position to stop swing

   (NOTE: Swinging and hoisting can be done at the same time as soon as bucket is high enough to clear any obstacles.)

E. Dump load

1. Keep holding line drum brake pedal firmly depressed; at the same time, release the closing line drum brake pedal

2. Depress the closing line drum pedal, and stop cable before the bucket halves open far enough to slam against the stops

3. As soon as clamshell unloads, swing clamshell back to material

4. Lower open bucket and repeat cycle

   (NOTE: When working in sticky material, the bucket may be opened hard against the stops to dislodge material.)

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

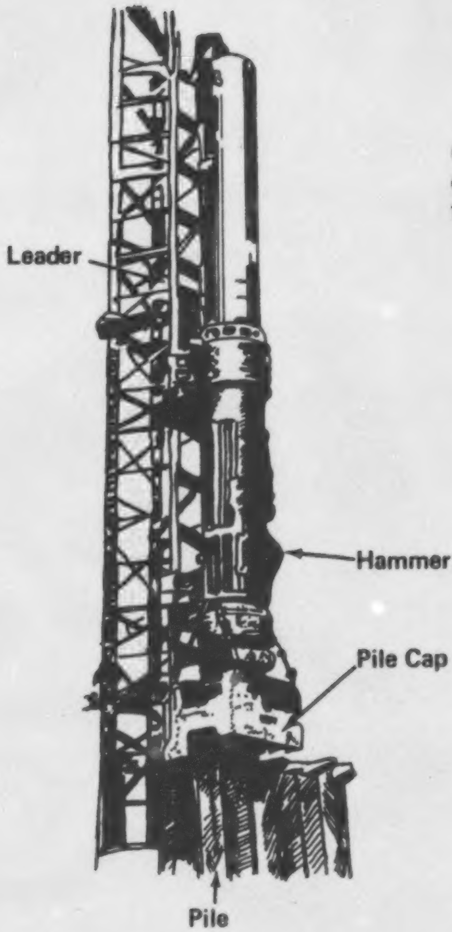
JOB SHEET #7--PERFORM A DIFFICULT JOB USING PILE HAMMER

I. Equipment

A. Crane

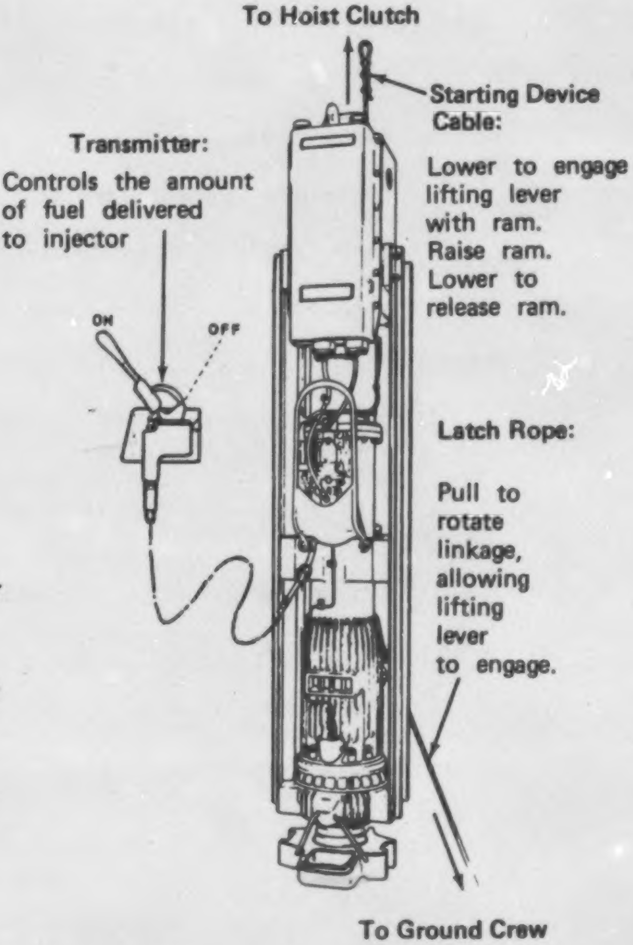
B. Diesel pile hammer attachment (Figures 27 and 28)

FIGURE 27


Leader
Hammer
Pile Cap
Pile

Used with permission of Pileco, Inc.

FIGURE 28


To Hoist Clutch
Starting Device Cable:
Lower to engage lifting lever with ram. Raise ram. Lower to release ram.
Transmitter:
Controls the amount of fuel delivered to injector
ON
OFF
Latch Rope:
Pull to rotate linkage, allowing lifting lever to engage.
To Ground Crew

JOB SHEET #7

II. Procedure

A. Fill fuel tank, oil reservoir, and starting fluid reservoir

B. Remove travel plug

C. Anchor remote control transmitter to a fixed object

D. Place hammer in leads and pick up leads

E. Raise hammer to top of leads

F. Attach pile line to top of pile

G. Drag pile slowly toward machine while gradually lifting up

H. Swing pile slowly under hammer

I. Set hammer gently on top of pile

J. Swing leads in position to drive pile

K. Set pile on ground at stake

L. Pull trip lever and start driving pile

M. Pull rope for trip safety mechanism, hold taut, and lower hammer line until trip mechanism engages ram piston

N. Set remote control transmitter between 90 and 100 psi (pounds per square inch)

O. Lift hammer line until trip mechanism disengages the ram piston

P. Apply drag on crane drum to hold hammer line taut

Q. Stop hammer by relaxing transmitter handle until hammer drops to 40 psi

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #8–REMOVE AND INSTALL COUNTERWEIGHT FROM A TRUCK CRANE

I. Equipment–Truck crane equipped with boom and hook block

II. Procedure

(NOTE: To prepare the truck crane for travel between job sites, the counterweight must be removed.)

A. Extend and set all outriggers

B. Raise the boom from cradle high enough to clear the cab

C. Engage the swing clutch control lever to swing the machine around until the counterweight is centered directly over the carrier with the boom over the rear

D. Pull the counterweight removal lever to retract the counterweight removal cylinders and raise the counterweight past its working position

E. Push the holding links lever to spread the holding links apart

F. Push the counterweight removal lever to extend the counterweight removal cylinders and lower the counterweight onto the carrier deck

(NOTE: Refer to manufacturer's operating manual for the specific controls and locks.)

G. With counterweight resting on the carrier deck, unpin the removal chains and pull the counterweight removal lever to retract the cylinders; raise the counterweight removal chains and the holding links away from the counterweight

(NOTE: The machine cannot swing until the counterweight removal chains are in the retracted position. The counterweight removal shaft bearings should be lubricated before and after each use of the counterweight removal device. Refer to the manufacturer's operating manual for types of lube and lube points. Performing the necessary lubrication while the crane is in this position gives the operator the advantage of standing on the carrier.)

H. Engage the swing clutch lever to swing the upper works around so that the boom is centered over the front of carrier

JOB SHEET #8

I. Engage the boom hoist clutch lever to raise the boom; at the same time, release the hoist line brake to lower the hook block; disengage boom hoist clutch lever when the hook block is directly over the counterweight

(NOTE: Performing two functions, booming and lowering hook block at the same time, requires constant observation of both to insure that the boom is not raised against the stops and that the hook block does not fall too fast and strike the carrier.)

J. Attach the hook block to the counterweight lift pins

K. Engage the hoist clutch lever to lift the counterweight off the carrier; when clear of the carrier, disengage the hoist clutch lever and depress the hoist brake

L. Engage the swing clutch lever and swing the load

M. Reinstall the counterweight on the machine by reversing the above procedures

(NOTE: When lowering the chains to hook on to the counterweight, it is not necessary to spread the holding links apart, as they will spread apart when they come in contact with the lift pins.)

(CAUTION: Avoid personal injury; be sure that personnel are clear of the counterweight before raising or lowering it. Do not allow anyone to get any part of his/her body between the counterweight and the machine.)

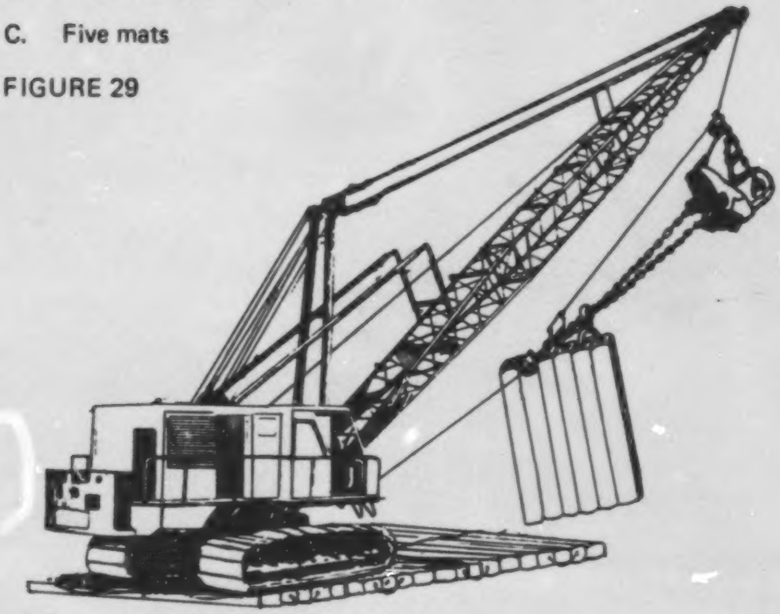
CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

JOB SHEET #9--PERFORM DRAGLINE OPERATIONS IN UNSTABLE SOIL

I. Equipment and materials (Figure 29)

- A. Crawler crane
- B. Dragline attachment
- C. Five mats

FIGURE 29



II. Procedure

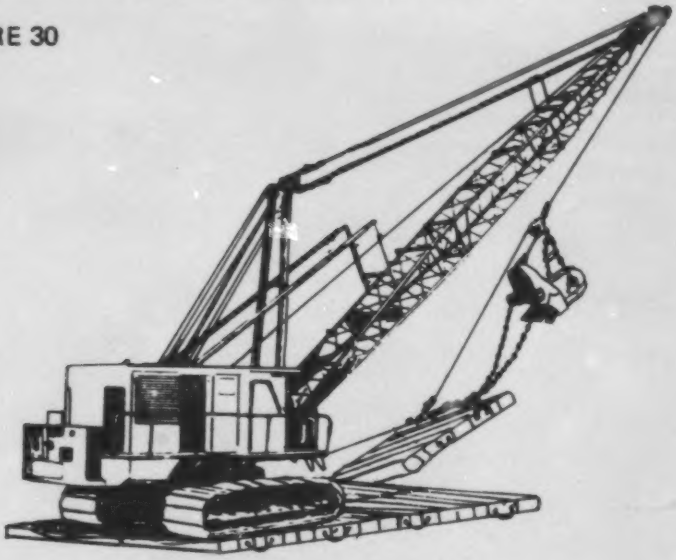
- A. Determine exactly where the mats should be placed
- B. Lift drag bucket by raising hoist line
- C. Take in dragline to pull bucket toward crane
- D. Swing boom over mats and lower hoist line

  (NOTE: At this point, a short sling will be attached from the drag chain to the eye of the cable on one end of the mat.)
- E. Raise hoist line until the mat is clear of the haul unit
- F. Use swing control lever to swing crane in position for setting mat

JOB SHEET #9

G. Lower the hoist line until end of mat is in correct position (Figure 30)

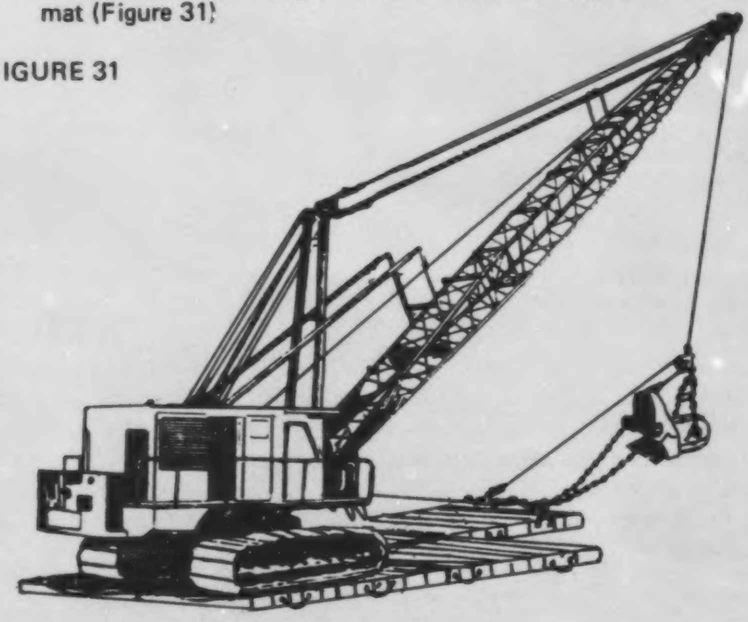
FIGURE 30



H. Continue lowering hoist line until the mat is flat on the ground

I. Lower hoist line a slight bit more until the sling can be removed from the mat (Figure 31)

FIGURE 31



JOB SHEET #9

J. Raise hoist line and swing to haul unit to pick up next mat

K. Repeat the steps of lifting, swinging, and placing mats side-by-side until all five are set in place

(NOTE: After all the mats are in place, swing the boom around to face direction of travel.)

L. Engage travel clutch and cautiously walk crane forward onto the mats

M. Travel forward until front of tracks are on the last mat laid

N. Disengage travel clutch to stop forward motion

O. Engage swing clutch to swing boom around 180 degrees; lower hoist line so that sling can be reconnected to the exposed mat

P. Engage hoist line clutch to raise mat high enough to clear the ground or any other obstructions; disengage hoist line clutch when desired height is reached

Q. Engage swing clutch to swing boom around almost 180 degrees; lower hoist line until end of mat is resting on the ground, then depress hoist line brake

R. Engage swing clutch gradually as the boom starts to swing; release the hoist line brake slowly in time with the swing to cause the mat to be placed in line with the other mats

(NOTE: If the swing is faster than the lowering of the hoist line, the mat will be pulled away from the correct position; if this happens, the mat will have to be raised again and swung back into the correct position.)

S. Repeat the procedure of traveling forward on the mats and moving the mats forward until the crane is in the proper position to start excavating

(NOTE: At this time the mats must be positioned to allow a series of forward and backward turning movements that reposition the tracks of the crane so that the drive sprockets are to the rear of the crane. During the course of travel, if it becomes necessary to make turns, the mats can be laid at a slight angle. If mud is allowed on the mats, causing track slippage during turns, a few bolts can be installed through the holes in the track pads for better traction.)

T. Repeat procedures of traveling crane forward and picking and moving mats, then swinging back to resume digging, until project is complete

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

TEST

NAME________________________________ SCORE ______________

1. Describe the uses of cable cranes.

____

____

____

2. Match terms associated with cable cranes to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the next page.

_____a. Bucket attachment connected to crane by cable arrangement that provides the ability to do excavation

_____b. Secondary parts or assembly of parts, which add to the crane's function and usefulness

_____c. Type of bucket that has a set of jaws

_____d. Hinged extension on the end of a boom that is used to increase height

_____e. Destroying or tearing down

_____f. Hinged piece on the revolving crane; used as a part of an attachment

_____g. Outward extensions of frame supported by a jack or block; used to make equipment more stable

_____h. Includes safety hook, bearing block, thrust bearing, brass bushing, and side weights

_____i. To move by throwing

_____j. Having no "give" or slack

_____k. Threading or placing working lines

1. Outriggers
2. Taut
3. Demolition
4. Dragline
5. Cast
6. Attachments
7. Jib mast
8. Boom
9. Clamshell
10. Hook block assembly
11. Reeving

TEST

_____l. Surface or contact area of a drum or flat pulley, especially a detachable surface or one of special composition

_____m. An overhead structure that supports machines or operating parts

_____n. Fixed boom support cable

_____o. A tooth or set of teeth designed to lock against a ratchet

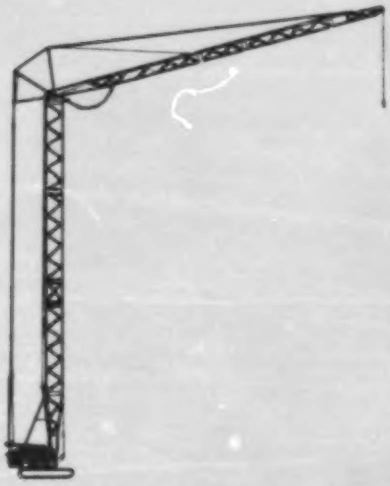
_____p. Line from a crane boom to a clamshell bucket that holds bucket and keeps it from spinning out of position

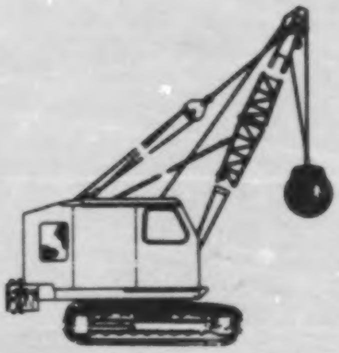
_____q. Dead or nonworking load attached to end of machine to balance weight carried on opposite end

_____r. Braces

12. Pendant
13. Lagging
14. Automatic tagline
15. Pawl (dog)
16. Gantry
17. Backstays
18. Counterweight

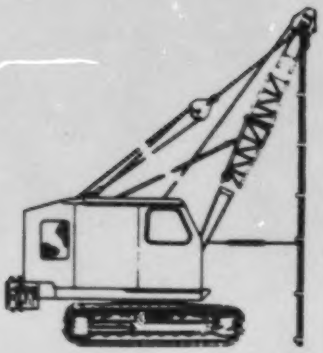
3. Label the following accessories and/or attachments used on cable cranes. Write the correct names in the blanks.



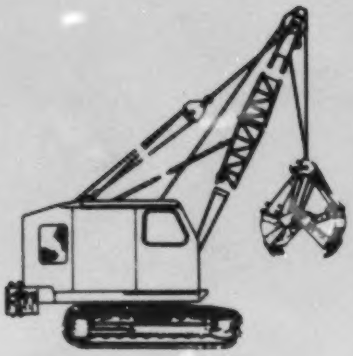


a. ______________________________ b. ______________________________

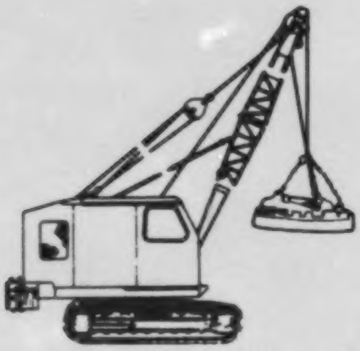
TEST



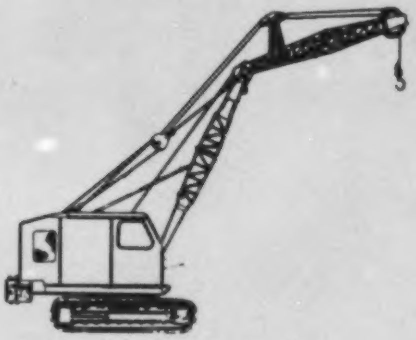
c. ____________________



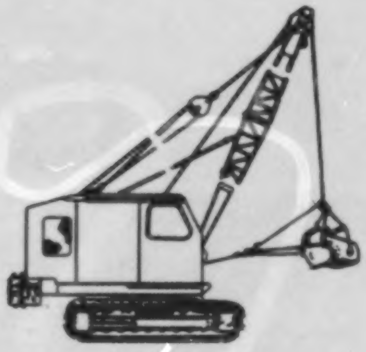
d. ____________________



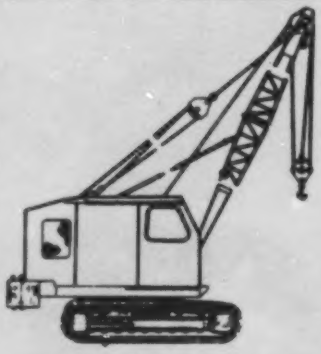
e. ____________________



f. ____________________

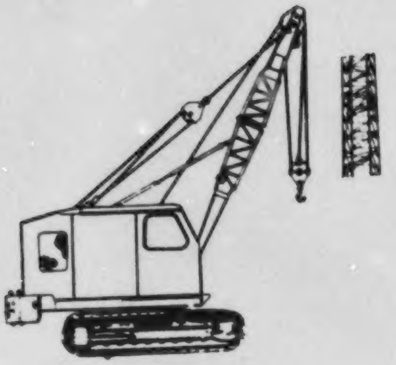


g. ____________________

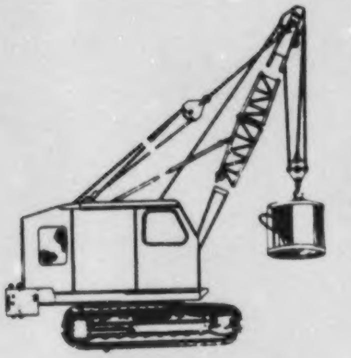


h. ____________________

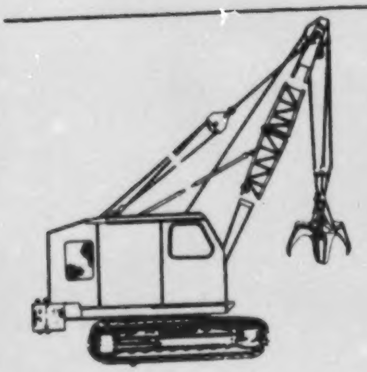
TEST



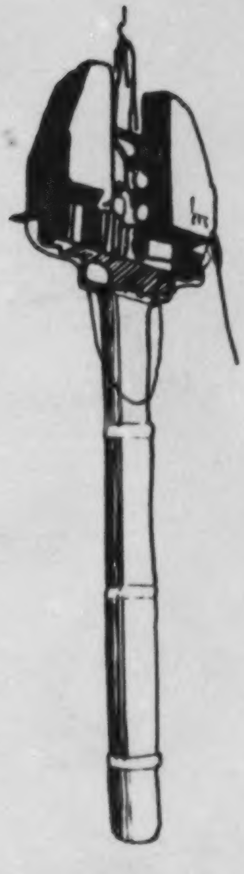
i. ______________________



j. ______________________



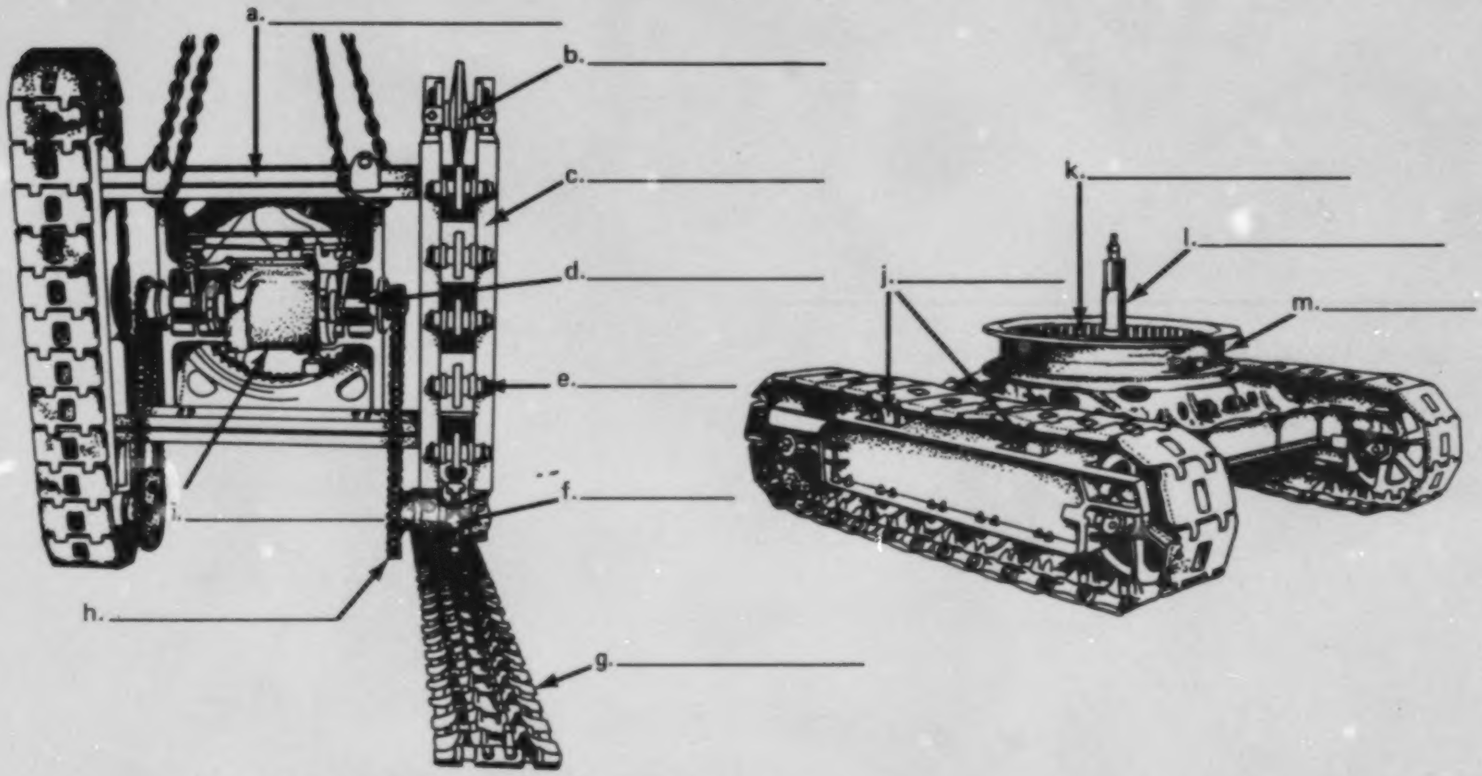
k. ______________________



l. ______________________

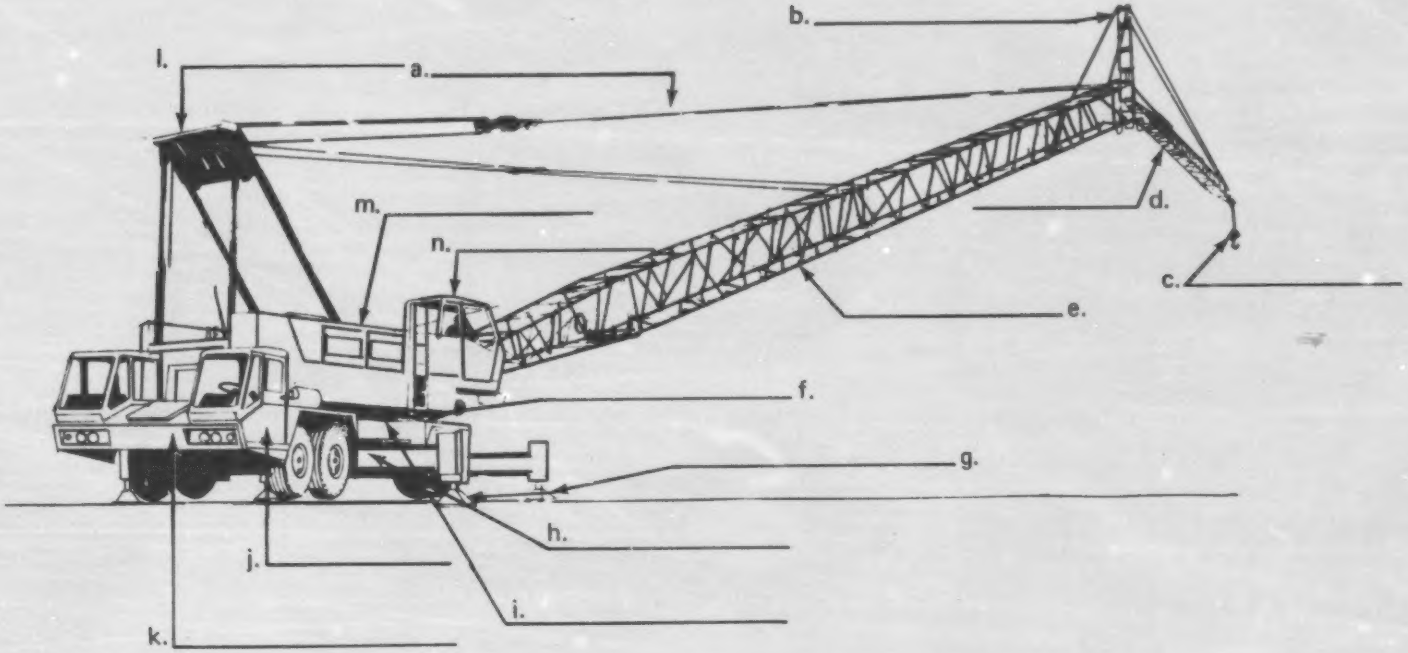
TEST

4. Label the basic components of a crawler cable crane. Write the correct names in the blanks.


a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.
m.

TEST

5. Label the basic components of a truck cable crane. Write the correct names in the blanks.


a.
b.
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n.

TEST

6. List information that the operator needs to determine capabilities of equipment quickly.

a. ______

b. ______

c. ______

d. ______

e. ______

f. ______

g. ______

h. ______

7. Select from the following list items to check on daily inspection. Write an "X" in the blank before each correct answer.

______a. Cooling system

______b. Drive shaft

______c. Cab cleanliness

______d. Brakes

______e. Ring pins

______f. Cables, drum assemblies, and attachments

______g. Ring gears

______h. Clutch pressure plates; adjust pressure if necessary

______i. Engine oil level

______j. Transmission fluid level

______k. Plates in battery; service when necessary

8. State five safety factors for setting up a crane.

a. ______

b. ______

c. ______

d. ______

e. ______

TEST

9. Select from the following list factors to consider when determining the correct attachment for a job. Write an "X" in the blank before each correct answer.

_____a. Lift radius

_____b. Number of lifts

_____c. Weather conditions

_____d. Site conditions

_____e. Weights and dimensions of heaviest and largest loads

_____f. Weight of equipment

_____g. Length of outriggers

_____h. Height of lift

10. Select from the following list procedures to perform after warm up. Write an "X" in the blank before each correct answer.

_____a. Check manifold heat

_____b. Check tire gauges for proper pressure

_____c. Operate controls that move crane forward and backward

_____d. Operate controls to raise and lower boom

_____e. Operate controls to raise and lower load

_____f. Operate controls to turn and swing boom

_____g. Operate controls to open concrete bucket

_____h. Operate controls to swing pile driver

_____i. Check gauges for proper pressures and temperature

(NOTE: Test question 11 lists the job sheets. These are an important part of this test. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

a. Service a crane.

b. Start, warm up, and check gauges and performance of controls on a crane.

c. Dismantle boom from crane.

d. Spot crane, lift, swing, and lower load.

e. Perform a basic job using dragline.

TEST

f. Perform an intermediate job using clamshell.

g. Perform a difficult job using pile hammer.

h. Remove and install counterweight from a truck crane.

i. Perform dragline operations in unstable soil.

CABLE CRANES (CRAWLER AND TRUCK)
UNIT I

ANSWERS TO TEST

1. Description should include

   Basically for hoisting, but with the use of different attachments, becomes a very versatile piece of equipment

2. a. 4
   b. 6
   c. 9
   d. 7
   e. 3
   f. 8
   g. 1
   h. 10
   i. 5
   j. 2
   k. 11
   l. 13
   m. 16
   n. 12
   o. 15
   p. 14
   q. 18
   r. 17

3. a. Tower attachment
   b. Demolition (breaker ball)
   c. Pile hammer
   d. Clamshell
   e. Magnet
   f. Jib boom (jib mast)
   g. Dragline
   h. Crane hook (hook block)
   i. Boom extension
   j. Concrete bucket
   k. Tong grapple
   l. Vibratory probe

ANSWERS TO TEST

4. a. Dead axle
   b. Idler
   c. Truck frame
   d. Live axle
   e. Track roller
   f. Bull wheel
   g. Track
   h. Drive chain
   i. Transmission case
   j. Support roller
   k. Bull gear
   l. Center pintle
   m. Turntable

5. a. Pendant
   b. Jib support gantry
   c. Hook block
   d. Jib
   e. Boom
   f. Turntable
   g. Outrigger floats
   h. Outrigger beam
   i. Lower structure
   j. Driver's cab
   k. Carrier unit
   l. Gantry
   m. Upper structure
   n. Operator's cab

6. a. Crane model number, serial number, and date of manufacture
   b. Load ratings for main boom at all stated radii
   c. Boom angles
   d. Boom lengths
   e. Boom types
   f. Method of determining boom jib combination ratings
   g. Jib ratings (load and angle)
   h. Work areas for which capacities are listed in chart

7. a, c, d, f, i, j

ANSWERS TO TEST

8. Answer should include any five of the following
   - a. Consider your own safety and that of the public, all personnel, and property
   - b. Consider job site accessibility and safeness
   - c. Determine whether equipment will have to travel over ditches where pipe may be damaged
   - d. Allow sufficient room for erection and maneuverability
   - e. Ensure ample storage room for booms and components without interfering with maneuvers
   - f. Know the crane's maximum operating radius
   - g. Determine that the operating location is level and solid
   - h. Know what excavations, slopes, trenches, or embankments are near the location
   - i. Make sure that your view of other equipment is clear
   - j. Know the location of power lines within the work area

9. a, d, e, h

10. c, d, e, f, i

11. Performance skills evaluated to the satisfaction of the instructor

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify types of cranes and their major components. The student should also be able to perform different types of lifting jobs using safety precautions and proper rigging procedures. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of hydraulic cranes.
2. Match terms associated with hydraulic cranes to their correct definitions.
3. Identify major parts and components of a typical hydraulic crane.
4. Identify typical crane operating controls.
5. List optional equipment and/or accessories used on hydraulic cranes.
6. Select from a list information operators need to quickly determine capabilities of equipment.
7. Select from a list reasons for mobile crane failures and upsets.
8. State safety procedures that should be followed to rig a load properly.
9. Select from a list safety devices that all mobile cranes should be equipped with.
10. State precautions to observe during pick-and-carry operations and when traveling with an extended boom.
11. Complete a chart on uses and results of positions of the hoist-unit lever.
12. Match positions of the upper revolving frame's swing-motion lever to their correct uses.
13. State suggestions for effective crane operation.
14. Demonstrate the ability to
    a. Service a crane.
    b. Start, warm up, check gauges, check controls for proper performance, and shut down machine.

OBJECTIVE SHEET

c. Set up crane on job site.

d. Operate a hydraulic crane to hoist a lightweight load.

e. Operate a hydraulic crane to pour concrete.

f. Operate a hydraulic crane at maximum boom height and angle to set a maximum capacity load in place.

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order films or other materials planned to supplement unit.

      1. *The Weakest Link*. Color, 18 min., International Film Bureau Inc., 1978. Available from International Film Bureau Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

      2. *Craning with Confidence*. Color, 17 min., International Film Bureau Inc., 1980. Available from International Film Bureau Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

      3. *Heavy Construction Techniques: Unit 4*. Color, 15 min., Northeast Louisiana University, 1980. Available from Bobbs Merrill Educational Publishing, 4300 West 62nd St., P.O. Box 7080, Indianapolis, Indiana 46206.

   B. Provide students with objective sheet.

   C. Provide students with information and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. If job sheets are not practical, provide alternative jobs.

   H. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Service a Crane

      2. Job Sheet #2--Start, Warm Up, Check Gauges, Check Controls for Proper Performance, and Shut Down Machine

      3. Job Sheet #3--Set Up Crane on Job Site

SUGGESTED ACTIVITIES

4. Job Sheet #4--Operate a Hydraulic Crane to Hoist a Lightweight Load

5. Job Sheet #5--Operate a Hydraulic Crane to Pour Concrete

6. Job Sheet #6--Operate a Hydraulic Crane at Maximum Boom Height and Angle to Set a Maximum Capacity Load in Place

E. Test

F. Answers to test

III. Unit references

A. Dickie, D.E. *Crane Handbook.* Toronto: Construction Safety Association of Ontario, 1975.

B. *Features Bulletin: Drott Carrydeck Cranes.* Racine, Wisconsin: Drott Construction Equipment, Division of J.I. Case, n.d.

C. *Operating Instructions: 60-XC Hydrocrane.* South Milwaukee, Wisconsin: Bucyrus-Erie Company, n.d.

D. *Special Products Manual: Link-Belt® Cranes, Excavators, Diesel Pile Hammers.* Cedar Rapids, Iowa: FMC Corporation, Hydraulic Crane and Excavator Division, 1980.

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

INFORMATION SHEET

I. Uses of hydraulic cranes (Figures 1, 2, and 3)

(NOTE: Hydraulic cranes are sometimes called hydraulic-powered or hydraulic-operated.)

A. Hoisting materials and equipment

B. Picking and carrying materials and equipment

C. Lifting and setting equipment

FIGURE 1

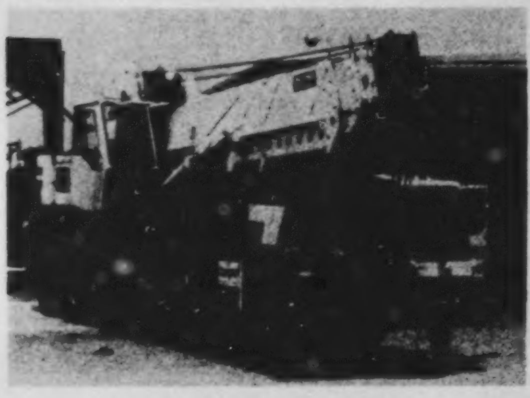
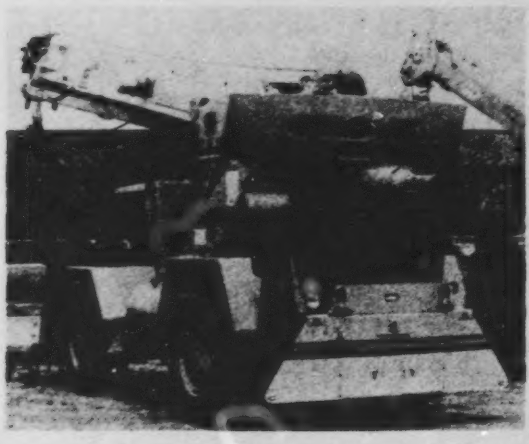


FIGURE 2

FIGURE 3



INFORMATION SHEET

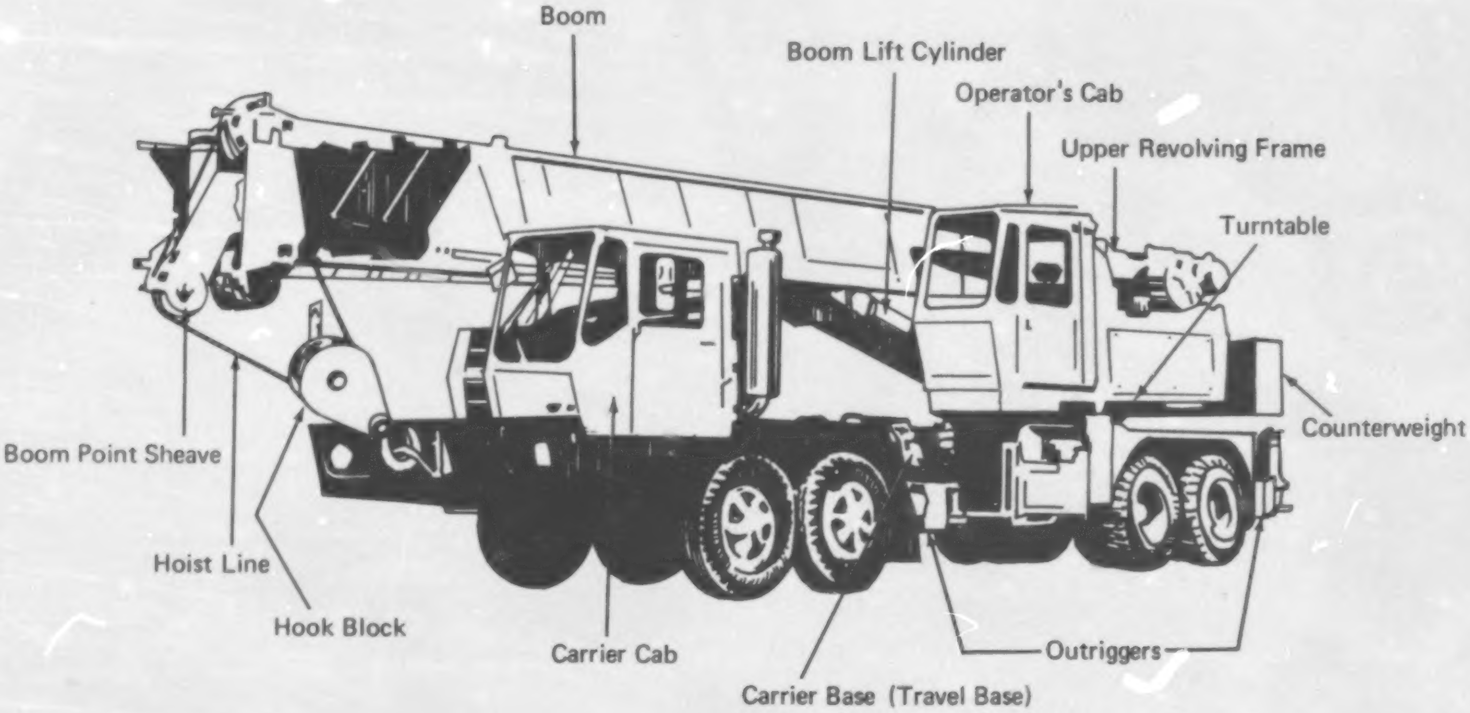
II. Terms and definitions

- A. Tagline--Line attached to load to help balance and guide load while being hoisted
- B. Gantry--Upward extension or tower of a revolving frame that holds boom line sheaves
- C. Counterweight--Dead or nonworking load attached to machine to improve balance when lifting heavy loads
- D. Reeving--Threading or placement of working lines
- E. Outrigger--Outward extension of a frame supported by a jack or block; used to stabilize machine
- F. Jib boom--Extension piece hinged to upper end of crane boom
- G. Pintle hook--Towing device consisting of a fixed lower jaw, a hinged and lockable upper jaw, and a socket in between to hold a tow ring
- H. Two block--Hook block pulled up against boom point sheave
- I. Sheave--Grooved wheel used to support cable and/or change its direction of travel
- J. Point load--A concentrated load
- K. Chock--Block used under and against an object to prevent it from rolling or sliding
- L. Whipline--Auxiliary hoist
- M. Two-part line--Single-strand rope or cable doubled back around a sheave so that two parts of it pull a load together

INFORMATION SHEET

III. Major parts and components of a typical hydraulic crane (Figure 4)

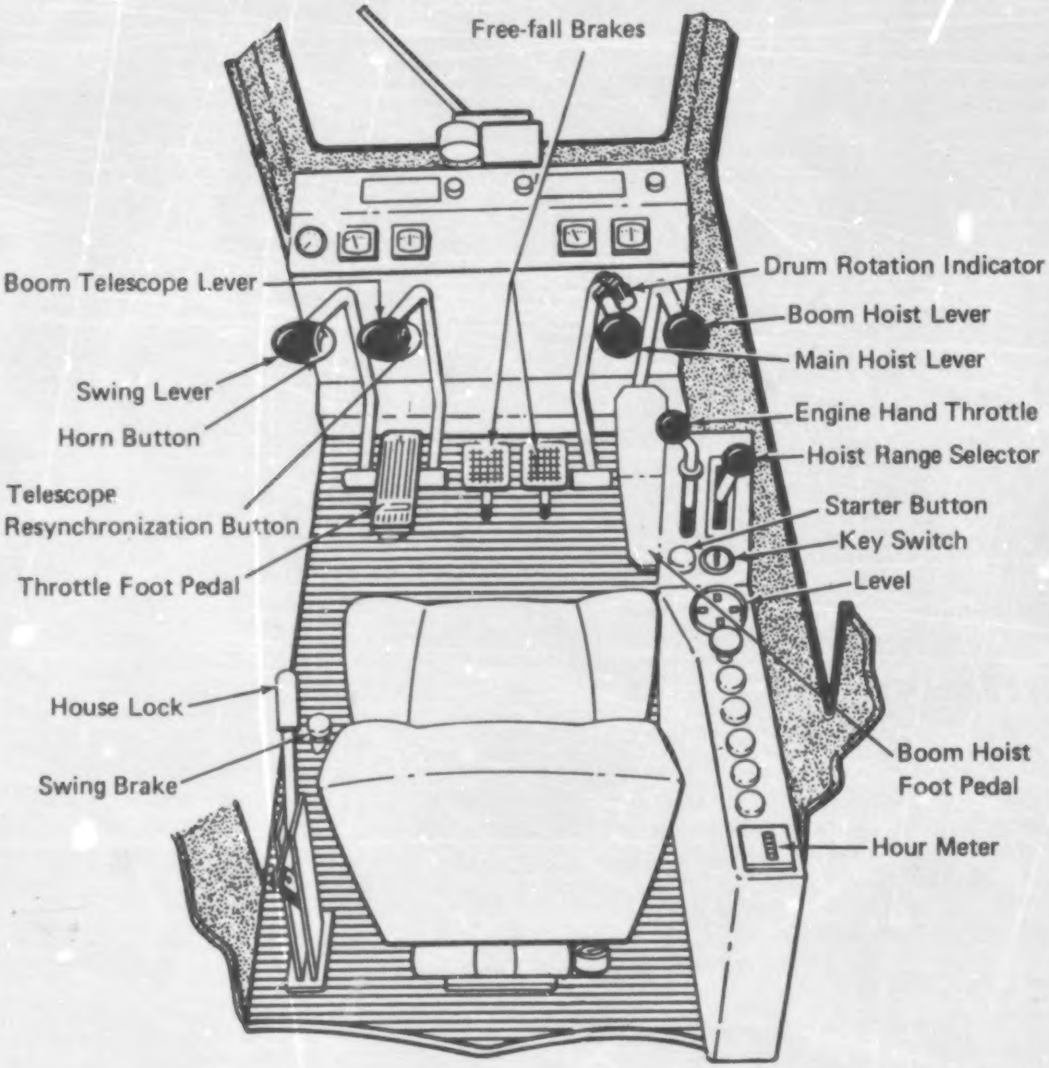
FIGURE 4


Boom
Boom Lift Cylinder
Operator's Cab
Upper Revolving Frame
Turntable
Counterweight
Boom Point Sheave
Hoist Line
Hook Block
Carrier Cab
Carrier Base (Travel Base)
Outriggers

INFORMATION SHEET

IV. Typical crane operating controls (Figure 5)

FIGURE 5


Free-fall Brakes
Boom Telescope Lever
Drum Rotation Indicator
Boom Hoist Lever
Main Hoist Lever
Swing Lever
Horn Button
Engine Hand Throttle
Hoist Range Selector
Telescope
Resynchronization Button
Starter Button
Key Switch
Throttle Foot Pedal
Level
House Lock
Swing Brake
Boom Hoist
Foot Pedal
Hour Meter

INFORMATION SHEET

V. Optional equipment and/or accessories used on hydraulic cranes

   A. Auxiliary winch

   B. Jib boom

   C. Pile driver

   D. Magnet

   E. Work platform

   F. Work basket

   G. Hook block

   H. Auxiliary sheave

   I. Pintle hook

   J. Concrete bucket

   K. Overhaul balls

VI. Information that operators need to quickly determine capabilities of equipment

   A. Crane model

   B. Serial number

   C. Date of manufacture

   D. Load ratings of main boom at all operating radii

   E. Boom angles

   F. Boom length

   G. Jib ratings

   H. Method of determining boom jib combined ratings

   I. Alternate load ratings when using optional equipment

   J. Recommended parts of hoist reeving; size and type of cable for various loads

   K. Precautionary notes about limitations of equipment and operating procedures

INFORMATION SHEET

L. Permissible line pull, line speeds, and line spooling capacity of drum

M. Wind velocity operating limits

N. Low temperature operating limits

O. Tire pressures

P. If hoist-holding mechanism is automatically or manually controlled and if free fall is available

(NOTE: This information and the information on telescopic boom can be found on a plate in cab of crane.)

Q. Telescopic boom information

1. Maximum telescopic travel length of each boom section

2. If sections are telescoped by power or manually

3. Sequence and procedure for extending and retracting boom sections

4. Maximum loads permitted during telescoping operations, and any limiting conditions or precautions

(NOTE: Warning on plate must indicate that no allowance is made for factors such as swinging loads, tackle weight, wind, degree of machine level, ground conditions, inflation of tires, or operating speeds.)

VII. Reasons for mobile crane failures and upsets

A. Failure to use outriggers

B. Improper setting of outriggers

C. Failure to level crane

D. Poor ground conditions

E. Improper blocking under outrigger floats

F. Too heavy a load when booming over sides

G. Failure to observe hazards such as electrical lines, excavations, and trenches

VIII. Safety procedures that should be followed to rig a load properly

A. Check safe working load of tackle and rigging being used

B. Check load weight before rigging it

C. Wear gloves when handling wire rope

INFORMATION SHEET

D. Never use defective hardware, tackle, or slings

E. Be sure all slings are equipped with identification numbers and marked for maximum capacity

F. Use corner pads, saddles, and padding or blocking to avoid pinching or crushing tackle and slings

G. Be sure lifting beams are plainly marked with weight and specified working loads

H. Use lifting beams only for the purpose for which they were designed

I. Never wrap hoist rope around load

J. Never make temporary repairs on cables or slings

K. Always secure unused legs of multi-leg sling before lifting

L. Never point load a hook unless it is specially designed and rated for such use

M. When using two or more slings together, be sure they are made of the same material and are evenly rated

N. Avoid using single-leg slings with hand-spliced eyes

(NOTE: Use Flemish-spliced eyes.)

O. Always use taglines when lifting heavy loads

IX. Safety devices that all mobile cranes should be equipped with

A. Self-closing filler caps and fuel tank flame arresters

B. Backup lights and backup warning signals

C. Wheel chocks

D. Rear-view mirrors on both sides

E. Fire extinguisher

F. Boom angle indicators

(NOTE: Indicator must be visible to the operator from the controls.)

G. Shock-absorbing boom stops

H. Boom hoist safety shutoffs

INFORMATION SHEET

I. Automatic devices for boom drum motion when maximum boom angle is reached

J. Electronic device that sounds buzzer and activates warning light when safe stress is exceeded

X. Precautions to observe during pick-and-carry operations and when traveling with an extended boom

(NOTE: Operator must use good judgment during these operations because of the many variables involved: ground conditions, boom length, swinging of load, jerking of load when starting and stopping, and others.)

A. Observe manufacturer's instructions for traveling procedures

B. Observe recommended safe separation distance between crane boom and high power lines

C. Exercise extreme caution working around high power wires

D. Exercise extreme caution when traveling with over 50 percent capacity loads

E. Set swing brake and swing lock

F. Always travel with a vehicle driver as well as an operator to control boom and/or hook block

G. Maintain correct tire pressure

H. Travel at a low speed

I. Avoid sudden starts and stops

J. Use taglines to control loads

K. Keep the load as close to ground as possible

L. Never travel with load over the side

M. Always use shortest boom possible

N. Never carry boom at highest angle

O. Be sure all personnel are clear of path

P. Avoid slopes and rough ground when possible

Q. Always place load on uphill side of equipment

INFORMATION SHEET

XI. Uses and results of positions of the hoist-unit lever

POSITION	USE	RESULT
Center	Remains neutral	Automatic brake is set to hold the load
Back	Raises load	Overrunning clutch allows brake to remain set while load is being raised
Forward	Lowers load	Automatic brake is hydraulically released during lowering operation; brake will reset when hoist control lever is released

(NOTE: Auxiliary hoist lever operates exactly the same way.)

XII. Uses of positions of the upper revolving frame's swing-motion lever

A. Center--Neutral

B. Pull back--Swing left

C. Push forward--Swing right

(NOTE: The swing lever is spring-returned to neutral when released. Hydraulic oil is not locked in lines when in neutral position; therefore, to stop swing, move control lever slightly beyond neutral position; this will "plug" the swing.)

XIII. Suggestions for effective crane operation

(NOTE: The following are constructive suggestions for improving operating efficiency.)

A. When repeated lifting is involved, crane should be positioned for shortest possible swing

B. Before lifting *any* load, level and firm footing should be maintained

C. Before moving or starting lifting operations, crane should be located to avoid any possible contact with power lines and/or overhead obstructions

D. Before starting lifting operations, all loads should be secured

E. Before moving or starting lifting operations, all personnel should be clear

INFORMATION SHEET

F. Swing crane slowly to avoid throwing load outward or overswinging

G. Use taglines to control load swing

H. Before releasing hitch, loads should be set on firm, solid footings

I. Before picking the load on capacity lifts, calculate and plan lifting cycle

J. When figuring height of lift, sling slack should be figured between hook and load, as well as block, hook, and boom deflection

K. Avoid too much booming up and down and telescoping

L. Avoid jerky operations

M. Have adequate length of hoist rope to provide safe travel of hook block from high position to lowest point required with heavy loads

(NOTE: There must be at least three full wraps of rope on drum when hook is in lowest position.)

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

JOB SHEET #1--SERVICE A CRANE

I. Equipment and materials

- A. Crane
- B. Tool kit
- C. Hydrometer for radiator
- D. Hydrometer and capacity tester for battery
- E. Air supply
- F. Brake tools
- G. Rule or tension gauge
- H. Grease gun
- I. Service manual
- J. Engine oil
- K. Engine coolant
- L. Fuel
- M. Hydraulic fluid
- N. Water
- O. Cleaning solution, brush, and new filters, if needed
- P. Brake fluid
- Q. New wires and/or connections, if necessary
- R. New belts, if necessary
- S. Lubricating grease

  (NOTE: Follow manufacturer's recommendations as to types of lubricants to use.)

- T. Shop rags
- U. Gloves

JOB SHEET #1

II. Procedure

A. Look for worn, missing, or damaged parts

B. Check engine oil; change or add oil if necessary

C. Check radiator and hose for leaks

D. Check radiator coolant; add if necessary

(NOTE: When weather is cold, check with hydrometer.)

E. Check fuel and add if necessary

F. Check hydraulic fluid and add if necessary

G. Check battery; add water if necessary

H. Check battery cables and connectors; clean and service if needed

I. Check fuel filter; drain and clean sediment bowl

J. Clean and service air cleaner; replace filter if necessary

K. Check transmission; add fluid if necessary

L. Check brakes; adjust if needed

M. Check wire connections and insulation; repair or replace if necessary

N. Check condition and adjustment of drive belts; adjust or replace if needed

O. Clean and lubricate all grease fittings

(NOTE: Use manufacturer's service chart, and follow manufacturer's specifications and recommendations as to amounts and types of lubricants.)

P. Check upper structure

Q. Check lower structure, wheels, tires, and drive line universals; clean and adjust if necessary

R. Fill out service chart

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

JOB SHEET #2–START, WARM UP, CHECK GAUGES, CHECK CONTROLS FOR PROPER PERFORMANCE, AND SHUT DOWN MACHINE

I. Equipment–Hydraulic crane

II. Procedure for carrier engine

(NOTE: Be sure crane boom is in cradle position.)

A. Mount carrier unit using steps and grab irons

B. Check to see that all controls are in neutral position

C. Apply brakes and lock

D. Place gears in neutral

E. Turn engine switch to "on"

F. Move accelerator lever down about 1/3 to 1/2 total distance

G. Depress starter button

(NOTE: Never operate starter more than 30 seconds at a time. If engine fails to start, wait 2 to 5 minutes before cranking again.)

H. Bring engine to fast idle, and warm up about five minutes

I. Make sure all gauges and instruments are working properly

(NOTE: If gauge does not indicate oil pressure within 15 seconds, stop engine and report malfunction to mechanic.)

J. Release brake

K. Shift to low gear

L. Manipulate controls to move forward or reverse

M. Check for proper operation of service brake

N. Check for proper operation of steering

O. Shift to neutral

P. Reset parking brake

Q. Turn engine switch to "off"

R. Dismount carrier unit using steps and grab irons; make final visual check

JOB SHEET #2

III. Procedure for crane engine

A. Remount crane unit using steps and grab irons

B. Check to see that all controls are in neutral position

C. Apply brakes and lock

D. Place gears in neutral

E. Turn switch to "on"

F. Move accelerator lever down to about 1/3 to 1/2 total distance

G. Depress starter button

(NOTE: Never operate starter more than 30 seconds at a time. If engine fails to start, wait 2 to 5 minutes before cranking again.)

H. Bring engine to fast idle and warm up about five minutes

I. Make sure all gauges and instruments are working properly

(NOTE: If gauge does not indicate oil pressure within 15 seconds, stop engine and report malfunction to mechanic.)

J. Manipulate controls to extend or retract outriggers

K. Manipulate controls to set outrigger floats and level crane

L. Manipulate controls to raise boom clear of cab

M. Manipulate controls to swing upper structure

N. Manipulate controls to telescope boom in and out

(NOTE: Lower hook block to prevent two-blocking.)

O. Manipulate controls to hoist hook block up and down

P. Check boom hoist brake for proper operation

Q. Manipulate controls to set boom in cradle position

R. Be sure that all controls are in neutral and that brakes are locked

S. Dismount crane using steps and grab irons

T. Check for leaks, listen for abnormal noises, and be aware of any abnormal vibrations

U. Remount machine using steps and grab irons

V. Move accelerator lever to slow idle

JOB SHEET #2

W. Let engine cool down for about three minutes

X. Turn engine switch off

Y. Check again to see that all controls are in neutral and that brakes are locked

Z. Dismount crane using steps and grab irons

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

JOB SHEET #3--SET UP CRANE ON JOB SITE

I. Equipment and materials

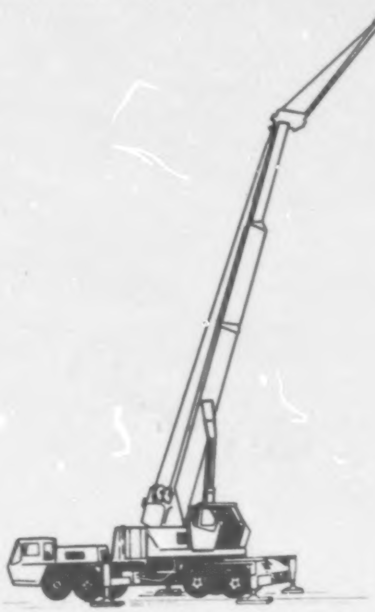
- A. Crane
- B. Pads

II. Procedure

- A. Proceed to job site
- B. Position crane on level ground
- C. Lock carrier brakes
- D. Place all controls in neutral position
- E. Remove lock pins and extend outriggers
- F. Reinsert lock pins
- G. Set pads
- H. Lower jack floats just enough to relieve pressure from the wheels and level machine (Figure 6)

  (NOTE: Check load chart to be sure lift can be made safely within the radius and known weight of load.)

FIGURE 6



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HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

JOB SHEET #4--OPERATE A HYDRAULIC CRANE TO HOIST A LIGHTWEIGHT LOAD

I. Equipment

  A. Hydraulic crane with hook block attachment

  B. Load

II. Procedure

  A. Engage boom hoist lever to raise boom

  (NOTE: Lower hook block to avoid two block.)

  B. Adjust boom so that point sheaves are same distance on radius as load

  (NOTE: Some cranes are equipped with a boom lock that must be disengaged before boom can be lowered.)

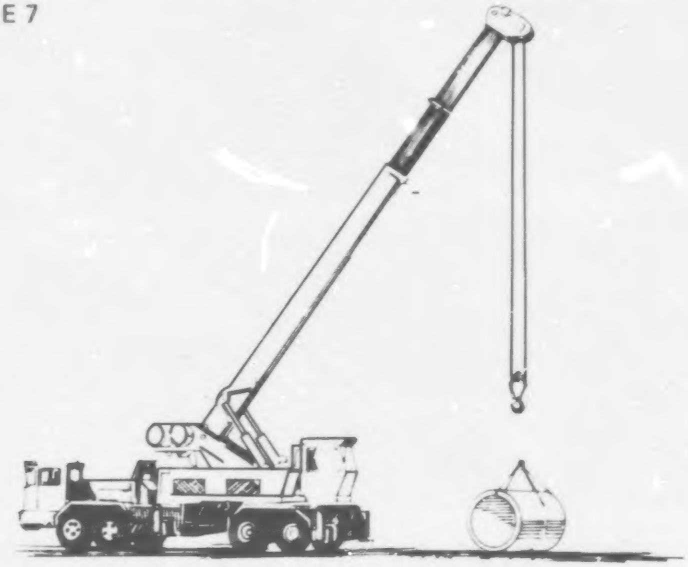
  (CAUTION: Check load chart to be sure lift can be made safely within the radius and known weight of load.)

  C. Return boom hoist lever to neutral position and reset hoist lock

  D. Disengage hoist drum brake to lower hook block to a point slightly above load (Figure 7)

  (NOTE: Be alert and respond to signal person's hand signals.)

FIGURE 7



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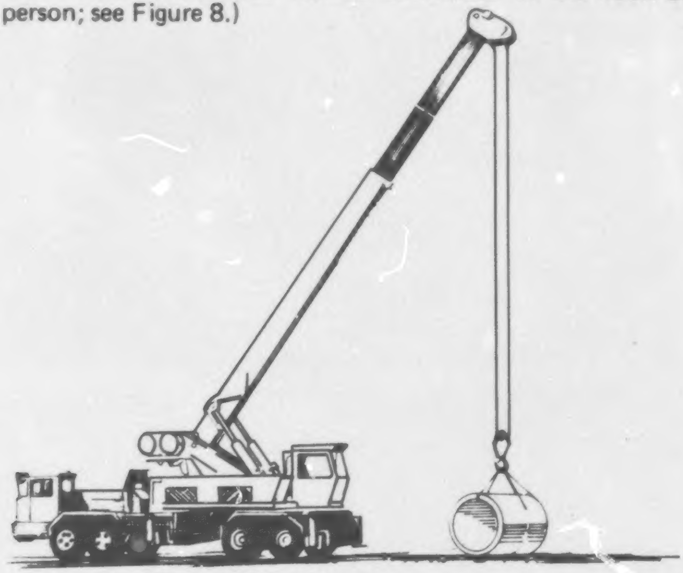
JOB SHEET #4

E. Depress hoist drum brake to stop fall of hook block

F. Readjust boom to center over load

(NOTE: At this time the load will be connected to the hook block by another person; see Figure 8.)

FIGURE 8



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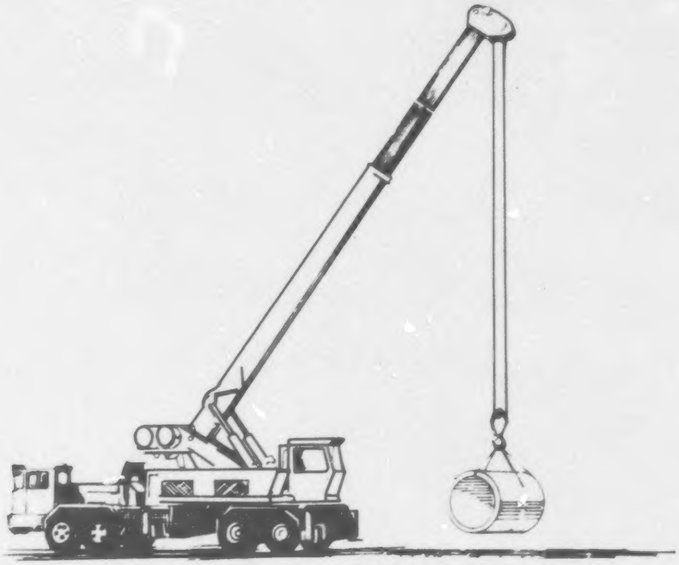
G. Raise load a few inches off ground by disengaging hoist drum brake while engaging drum lever (Figure 9)

FIGURE 9



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JOB SHEET #4

H. Stop upward travel of load by engaging hoist drum brake while disengaging hoist drum lever

I. Lock hoist drum brake

J. Disengage swing lock

K. Engage swing clutch lever to swing to right

L. Disengage swing clutch to stop swing

(NOTE: For positive stops, move the swing clutch lever slowly to left swing position and then immediately to neutral position.)

M. Engage swing lock

(NOTE: Determine exact location to spot load.)

N. Raise or lower boom if necessary by using boom hoist control lever

(NOTE: Boom lock must be released before boom can be lowered.)

O. Release hoist drum brake gradually to lower load slowly

(NOTE: If boom must be lowered, the hook block will have to be raised at the same time to prevent the load from hitting the ground.)

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

JOB SHEET #5--OPERATE A HYDRAULIC CRANE TO POUR CONCRETE

I. Equipment and materials

- A. Hydraulic crane
- B. Concrete bucket

II. Procedure

- A. Position hydraulic crane on work site

  (NOTE: Determine the exact spot the transit mix trucks will be spotted. Position crane in a manner that best suits the working radius to minimize the lowering and raising of the boom.)

- B. Set outriggers

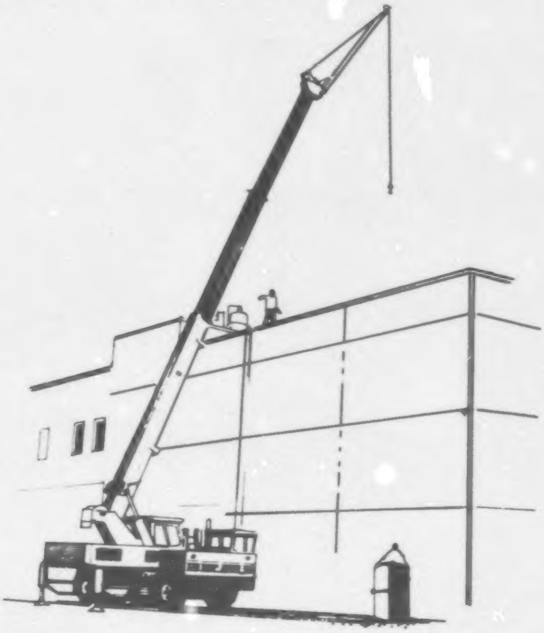
  (NOTE: Check footing under outriggers.)

- C. Lift boom from cradle
- D. Telescope boom extensions out evenly

  (NOTE: As boom is being extended, the hook block line has to be released to avoid two blocking.)

- E. Swing boom over concrete bucket (Figure 10)

FIGURE 10



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JOB SHEET #5

F. Release hook block brake to lower hook directly over concrete bucket; raise or lower boom for accurate centering

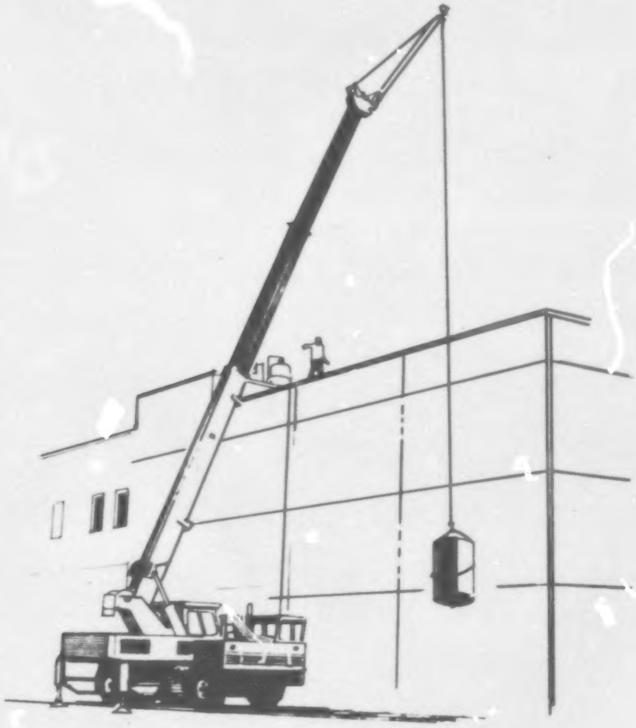
(NOTE: Using the known capacity of the bucket, the weight of concrete per cubic yard, and desired rate of pour, decide if it is better to use the whipline or a two-part line for speed.)

G. Reeve desired part of line

H. Attach hook into lift eye of concrete bucket, making sure safety hook is in place

I. Raise hoist line and concrete bucket just high enough to clear any objects on the ground (Figure 11)

FIGURE 11



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J. Swing boom to spot concrete bucket at point transit mix trucks will be discharging

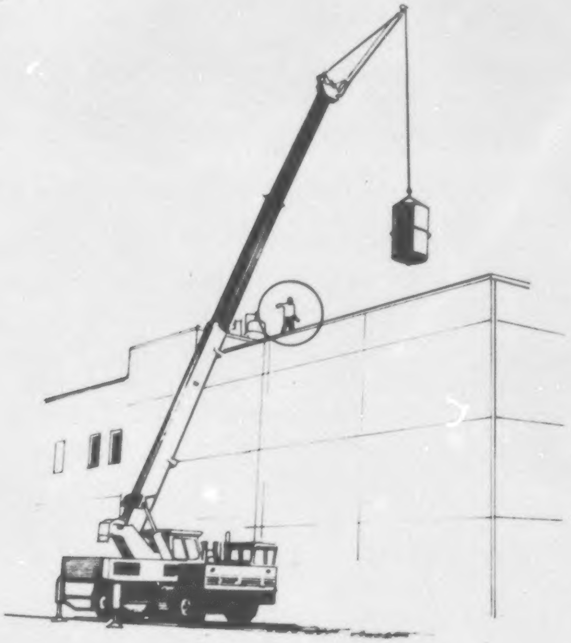
K. Raise hoist line and concrete bucket approximately half the distance to the point sheaves

JOB SHEET #5

L. Swing to bucket discharge position

(NOTE: Do not swing over workers' heads. Use signal person if location of forms is hidden from view. Use tagline person if bucket has to be moved through objects en route to discharge point; see Figure 12.)

FIGURE 12



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M. Raise or lower boom to center

N. Release brake to lower bucket to discharge point; test stopping ability of hoist brake

O. Raise hoist line and concrete bucket high enough to clear any objects on the ground

P. Swing boom back to transit mix truck

Q. Lower bucket to ground close enough so that chute on truck can be directed into bucket

R. Raise hoist line to lift loaded concrete bucket into air just high enough to clear objects on ground

JOB SHEET #5

S. Start swing gradually; maintain positive swing control and swing stop when bucket is positioned over discharge point

T. Release hoist line brake gradually to lower bucket to a point just above the forms at discharge point

(NOTE: Operator can expect a slight raising motion from the boom as the weight of the concrete is quickly dumped from the concrete bucket.)

U. Engage hoist line to raise empty bucket when signaled

V. Swing to return bucket to position under transit mix truck discharge chute

W. Continue to make repeated passes until pour is completed

(NOTE: As pour progresses at bucket discharge point, new positions may require the raising or lowering of the boom.)

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

JOB SHEET #6--OPERATE A HYDRAULIC CRANE AT MAXIMUM BOOM HEIGHT AND ANGLE TO SET A MAXIMUM CAPACITY LOAD IN PLACE

I. Equipment and materials

A. Hydraulic crane

B. Hook block

II. Procedure

A. Position hydraulic crane on work site

(NOTE: Observe and determinate location of maximum capacity load and point in the air that it is to be raised to.)

B. Set outrigger

(NOTE: Make sure ground under and around outrigger pads is stable.)

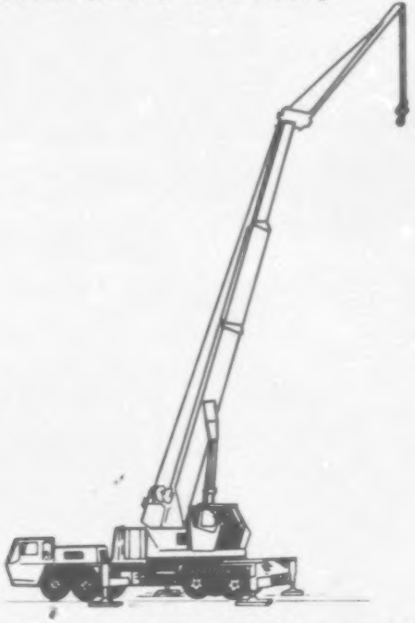
C. Lift boom from cradle

D. Telescope boom extensions out evenly to obtain maximum boom length (Figure 13)

(NOTE: Check load chart in operator's cab for maximum angle.)

(CAUTION: To avoid two-blocking while boom is being extended, hoist brake must be released to lower hook block.)

FIGURE 13



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JOB SHEET #6

E. Manipulate boom hoist lever to raise boom to desired maximum angle

(NOTE: Compare known weight of load to load chart to determine safe working radius.)

F. Swing boom for test over point that load will be placed

(NOTE: Consider the height of the load, and the slings and hook block to determine exact boom position. Check boom angle indicator and radius gauge to assure compliance with lifting chart.)

G. Engage boom swing gradually to swing boom over load to be lifted

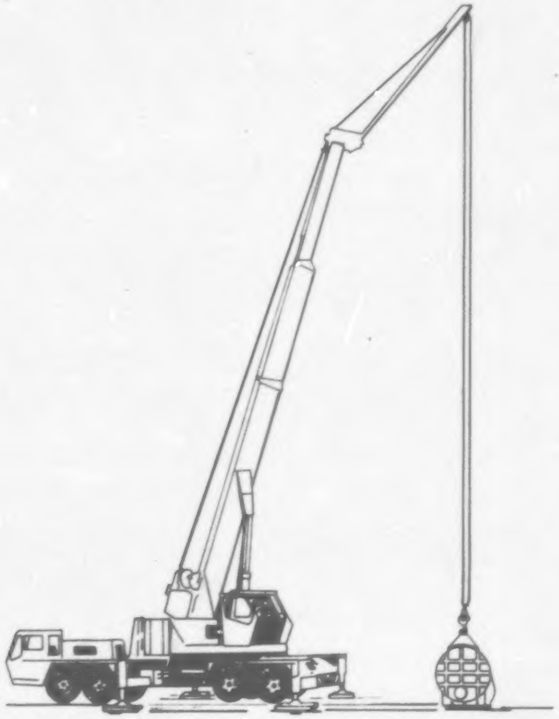
H. Disengage hoist line to allow hook block to lower; depress and lock hoist line brake when hook block is directly over load

(NOTE: Assure that proper number of lines are reeved through the hook block for maximum lift.)

I. Observe rigger and signal person attaching slings, spreaders, or straps from load to hook block

J. Engage hoist line lever when signaled, and at the same time release hoist line brake to raise hoist line and hook block to remove all the slack from rigging (Figure 14)

FIGURE 14



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JOB SHEET #6

K. Return hoist line lever to neutral; engage hoist line brake

L. To test crane and slings, engage hoist line lever while at the same time releasing hoist line brake

M. When load is off the ground approximately 6 inches, release hoist line lever and engage hoist line brake

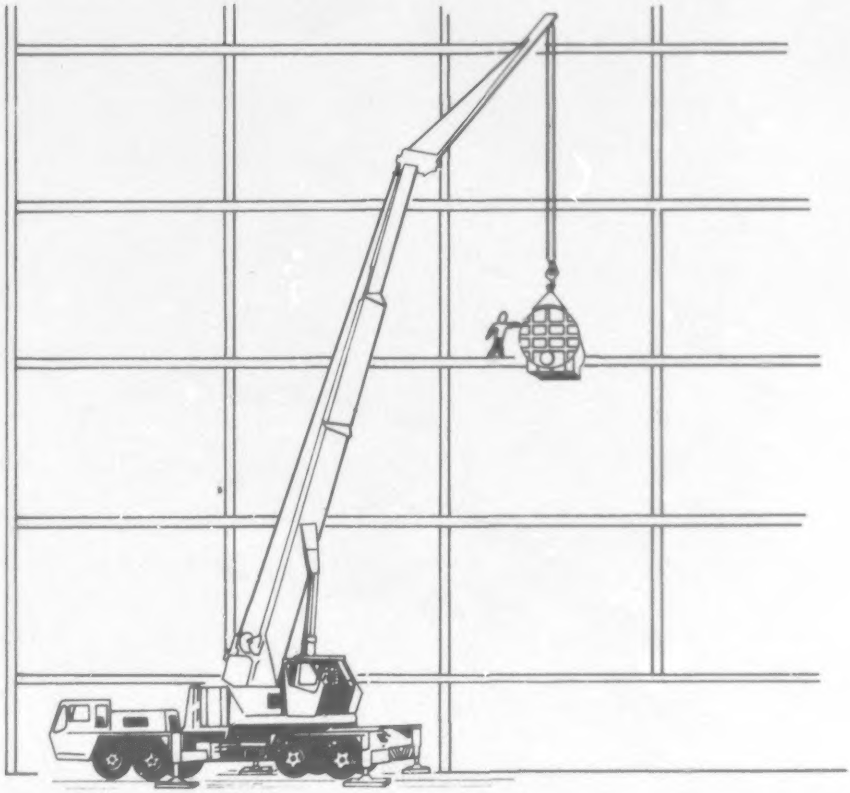
(NOTE: The operator and signal person *must* have complete confidence in each other. While the load is suspended 6 inches above the ground, the signal person observes the stability of the crane.)

N. Engage hoist lever when signaled, and at the same time disengage hoist brake

O. Raise load according to height designated by signal person

P. When signaled to hold the load, return hoist lever to neutral while at the same time engaging the hoist brake (Figure 15)

FIGURE 15



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JOB SHEET #6

Q. When signaled to swing, gradually engage the swing lever in the direction indicated by the signal person

R. Continue gradual, steady swing until signaled to stop

S. Return swing lever to neutral to stop swing

T. When signaled to lower the load, disengage hoist brake and activate the power down device, observing signal person for stop signal

U. Engage hoist brake when signaled to stop

V. When signaled to lower boom, engage boom hoist lever

W. When signaled to stop, return boom hoist lever to neutral

(NOTE: When signal person is satisfied that proper alignment is achieved and no more up or down boom movement is required, the signal is given to set the load in place.)

X. Disengage hoist line when signaled to lower the load

Y. Activate power down device and slowly set load in place

(NOTE: As the load comes to rest, re-engage hoist brake; do not immediately allow the rigging to go slack.)

Z. When signal person is assured that load is resting on a suitable base, disengage hoist line to lower

(NOTE: Power device is not required for this final lowering.)

AA. To allow rigger to remove the slings, spreaders, or straps from the load, depress hoist brake to stop downward travel of hook block above load

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. List uses of hydraulic cranes.

   a. ____

   b. ____

   c. ____

2. Match terms associated with hydraulic cranes to their correct definitions. Write the correct numbers in the blanks.

_____ a. Line attached to load to help balance and guide load while being hoisted

_____ b. Upward extension or tower of a revolving frame that holds boom line sheaves

_____ c. Dead or nonworking load attached to machine to improve balance when lifting heavy loads

_____ d. Threading or placement of working lines

_____ e. Outward extension of a frame supported by a jack or block; used to stabilize machine

_____ f. Extension piece hinged to upper end of crane boom

_____ g. Towing device consisting of a fixed lower jaw, a hinged and lockable upper jaw, and a socket in between to hold a tow ring

_____ h. Hook block pulled up against boom point sheave

_____ i. Grooved wheel used to support cable and/or change its direction of travel

_____ j. A concentrated load

_____ k. Block used under and against an object to prevent it from rolling or sliding

_____ l. Auxiliary hoist

_____ m. Single-strand rope or cable doubled back around a sheave so that two parts of it pull a load together

1. Tagline
2. Reeving
3. Two block
4. Jib boom
5. Sheave
6. Counterweight
7. Chock
8. Pintle hook
9. Outrigger
10. Gantry
11. Point load
12. Two-part line
13. Whipline

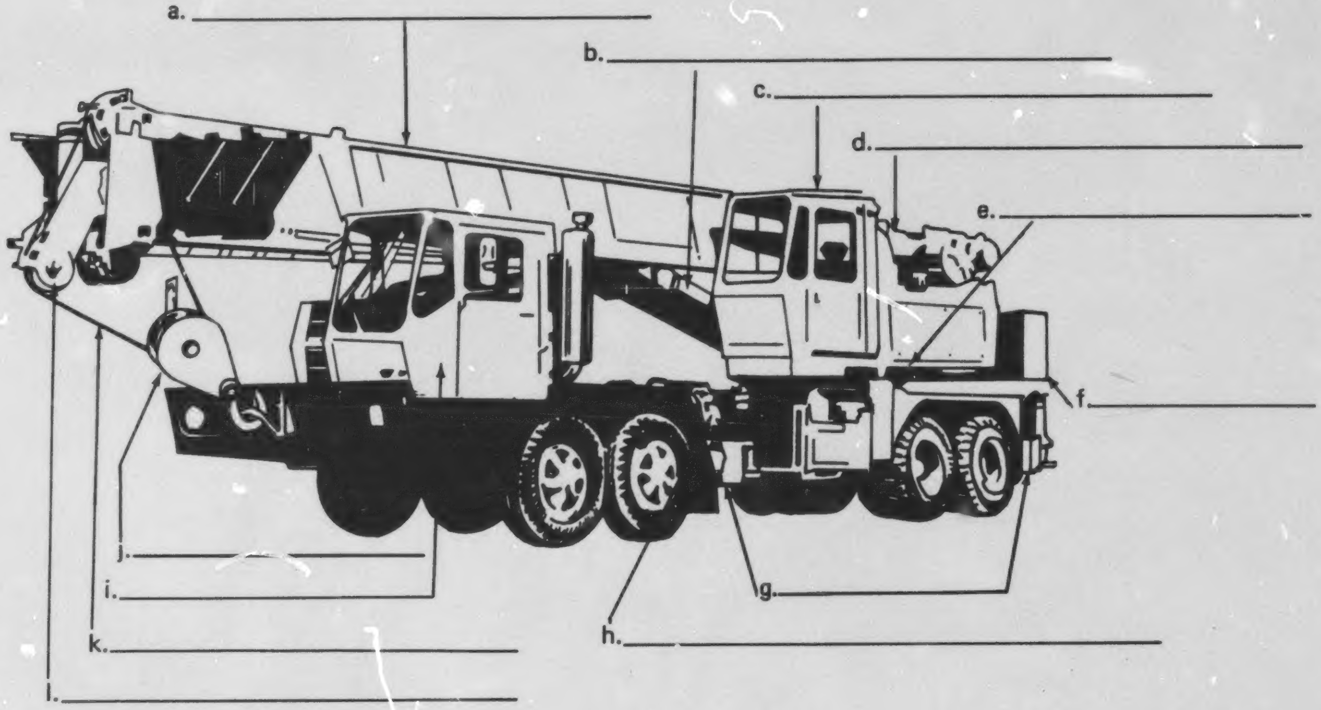
TEST

3. Identify major parts and components of a typical hydraulic crane. Write the correct names in the blanks.

Carrier cab
Operator's cab
Boom
Boom lift cylinder

Outriggers
Boom point sheave
Upper revolving frame
Counterweight

Turntable
Hook block
Hoist line
Carrier base (travel base)

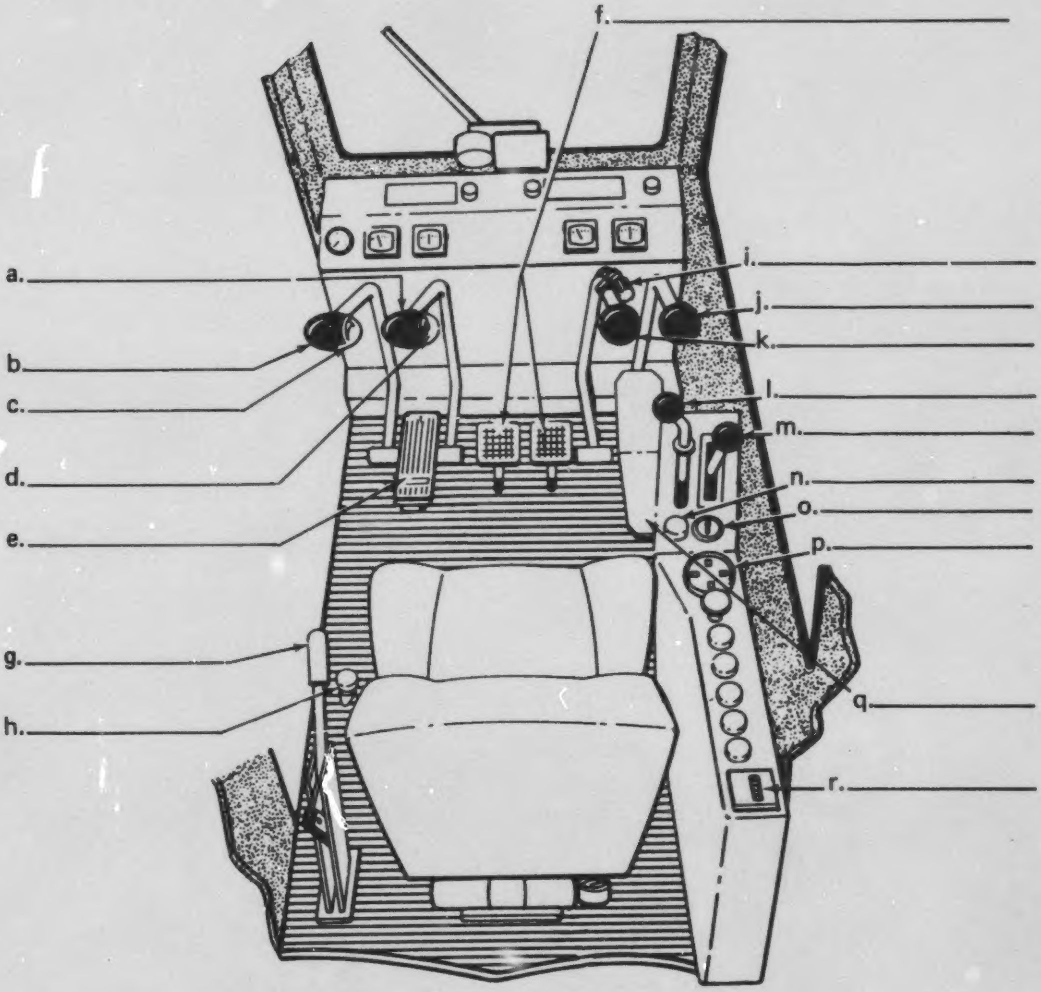


TEST

4. Identify typical crane operating controls. Write the correct names in the blanks.

Swing lever
Horn button
Telescope resynchronization button
Throttle foot pedal
House lock
Swing brake
Boom telescope lever
Free-fall brakes
Hour meter

Drum rotation indicator
Boom hoist lever
Main hoist lever
Engine hand throttle
Hoist range selector
Starter button
Key switch
Level
Boom hoist foot pedal



TEST

5. List eight optional pieces of equipment and/or accessories used on hydraulic cranes.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

6. Select from the following list information operators need to quickly determine capabilities of equipment. Write an "X" in the blank before each correct answer.

_____a. Wheel size

_____b. Load ratings of main boom at all operating radii

_____c. Boom angles

_____d. Boom weight

_____e. Shape of hook block

_____f. Method of determining boom jib combined ratings

_____g. Precautionary notes about limitations of equipment and operating procedures

_____h. Horsepower and number of cylinders in engine

_____i. Permissible line pull, line speeds, and line spooling capacity of drum

_____j. Number of boom sections

_____k. Sequence and procedure for extending and retracting boom sections

_____l. Maximum telescopic travel length of each boom section

TEST

7. Select from the following list reasons for mobile crane failures and upsets. Write an "X" in the blank before each correct reason.

______a. Too heavy a load when booming over sides

______b. Improper setting of outriggers

______c. Failure to observe hazards such as electrical lines, excavations, and trenches

______d. Failure to level bucket

______e. Failure to use outriggers

______f. Improper blocking under wheels

______g. Improper blocking under outrigger floats

______h. Poor ground conditions

______i. Cables not reeved correctly

______j. Improper track adjustment

8. State ten safety procedures that should be followed to rig a load properly.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

9. Select from the following list safety devices that all mobile cranes should be equipped with. Write an "X" in the blank before each correct answer.

______a. Flag person

______b. Fire extinguisher

______c. Shock-absorbing boom stops

TEST

_____d. Outrigger tilt indicators

_____e. Boom angle indicators

_____f. Boom hoist safety shutoffs

_____g. Automatic device that warns when boom is too high

_____h. Backup lights and backup warning signals

_____i. Rear-view mirrors on both sides

_____j. Electronic device that sounds buzzer and activates warning light when safe stress is exceeded

10. State ten precautions to observe during pick-and-carry operations and when traveling with an extended boom.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

i. ____________________

j. ____________________

11. Complete the following chart on uses and results of positions of the hoist-unit lever. Write the correct information in the blanks.

POSITION	USE	RESULT
Center	Remains neutral	a. ____________________
Back	b. ____________________	c. ____________________

TEST

POSITION	USE	RESULT
Forward	d. ____________________ ____________________	e. ____________________ ____________________ ____________________ ____________________

12. Match positions of the upper revolving frame's swing-motion lever to their correct uses. Write the correct numbers in the blanks.

_____ a. Center	1. Swing right
_____ b. Pull back	2. Neutral
_____ c. Push forward	3. Swing left

13. State eight suggestions for effective crane operation.

a. ____
____

b. ____
____

c. ____
____

d. ____
____

e. ____
____

f. ____
____

g. ____
____

h. ____
____

TEST

(NOTE: Test question 14 lists the job sheets. These are an important part of this unit. If they have not been completed, check with your instructor.)

14. Demonstrate the ability to

    a. Service a crane.

    b. Start, warm up, check gauges, check controls for proper performance, and shut down machine.

    c. Set up crane on job site.

    d. Operate a hydraulic crane to hoist a lightweight load.

    e. Operate a hydraulic crane to pour concrete.

    f. Operate a hydraulic crane at maximum boom height and angle to set a maximum capacity load in place.

HYDRAULIC CRANES (CRAWLER AND TRUCK)
UNIT II

ANSWERS TO TEST

1. a. Hoisting materials and equipment

   b. Picking and carrying materials and equipment

   c. Lifting and setting equipment

2. a. 1

   b. 10

   c. 6

   d. 2

   e. 9

   f. 4

   g. 8

   h. 3

   i. 5

   j. 11

   k. 7

   l. 13

   m. 12

3. a. Boom

   b. Boom lift cylinder

   c. Operator's cab

   d. Upper revolving frame

   e. Turntable

   f. Counterweight

   g. Outriggers

   h. Carrier base (travel base)

   i. Carrier cab

   j. Hook block

   k. Hoist line

   l. Boom point sheave

4. a. Boom telescope lever

   b. Swing lever

   c. Horn button

   d. Telescope resynchronization button

   e. Throttle foot pedal

   f. Free-fall brakes

   g. House lock

   h. Swing brake

   i. Drum rotation indicator

   j. Boom hoist lever

   k. Main hoist lever

   l. Engine hand throttle

   m. Hoist range selector

   n. Starter button

   o. Key switch

   p. Level

   q. Boom hoist foot pedal

   r. Hour meter

ANSWERS TO TEST

5. Answer should include any eight of the following

    a. Auxiliary winch

    b. Jib boom

    c. Pile driver

    d. Magnet

    e. Work platform

    f. Work basket

    g. Hook block

    h. Auxiliary sheave

    i. Pintle hook

    j. Concrete bucket

    k. Overhaul balls

6. b, c, f, g, i, k, l

7. a, b, c, e, g, h

8. Answer should include any ten of the following

    a. Check safe working load of tackle and rigging being used

    b. Check load weight before rigging it

    c. Wear gloves when handling wire rope

    d. Never use defective hardware, tackle, or slings

    e. Be sure all slings are equipped with identification numbers and marked for maximum capacity

    f. Use corner pads, saddles, and padding or blocking to avoid pinching or crushing tackle and slings

    g. Be sure lifting beams are plainly marked with weight and specified working loads

    h. Use lifting beams only for the purpose for which they were designed

    i. Never wrap hoist rope around load

    j. Never make temporary repairs on cables or slings

    k. Always secure unused legs of multi-leg sling before lifting

    l. Never point load a hook unless it is specially designed and rated for such use

    m. When using two or more slings together, be sure they are made of the same material and are evenly rated

ANSWERS TO TEST

   n. Avoid using single-leg slings with hand-spliced eyes

   o. Always use taglines when lifting heavy loads

9. b, c, e, f, h, i, j

10. Answer should include any ten of the following

    a. Observe manufacturer's instructions for traveling procedures

    b. Observe recommended safe separation distance between crane boom and high power lines

    c. Exercise extreme caution when working around high power wires

    d. Exercise extreme caution when traveling with over 50 percent capacity loads

    e. Set swing brake and swing lock

    f. Always travel with a vehicle driver as well as an operator to control boom and/or hook block

    g. Maintain correct tire pressure

    h. Travel at a low speed

    i. Avoid sudden starts and stops

    j. Use taglines to control loads

    k. Keep load as close to ground as possible

    l. Never travel with load over the side

    m. Always use shortest boom possible

    n. Never carry boom at highest angle

    o. Be sure all personnel are clear of path

    p. Avoid slopes and rough ground when possible

    q. Always place load on uphill side of equipment

11. a. Automatic brake is set to hold the load

    b. Raises load

    c. Overrunning clutch allows brake to remain set while load is being raised

ANSWERS TO TEST

   d. Lowers load

   e. Automatic brake is hydraulically released during lowering operation; brake will reset when hoist control lever is released

12. a. 2

   b. 3

   c. 1

13. Answer should include any eight of the following

   a. When repeated lifting is involved, crane should be positioned for shortest possible swing

   b. Before lifting *any* load, level and firm footing should be maintained

   c. Before moving or starting lifting operations, crane should be located to avoid any possible contact with power lines and/or overhead obstructions

   d. Before starting lifting operations, all loads should be secured

   e. Before moving or starting lifting operations, all personnel should be clear

   f. Swing crane slowly to avoid throwing load outward or overswinging

   g. Use taglines to control load swing

   h. Before releasing hitch, loads should be set on firm, solid footings

   i. Before picking the load on capacity lifts, calculate and plan lifting cycle

   j. When figuring height of lift, sling slack should be figured between hook and load, as well as block, hook, and boom deflection

   k. Avoid too much booming up and down and telescoping

   l. Avoid jerky operations

   m. Have adequate length of hoist rope to provide safe travel of hook block from high position to lowest point required with heavy loads

14. Performance skills evaluated to the satisfaction of the instructor

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to manipulate controls to operate bridge, tower, and gantry cranes safely and efficiently. The student should also be able to perform basic hoisting and traveling operations. This knowledge will be shown by completing assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of bridge, tower, and gantry cranes.
2. Match terms associated with bridge, tower, and gantry cranes to their correct definitions.
3. Match bridge, tower, and gantry cranes to their correct descriptions.
4. Identify basic components of a bridge crane.
5. Identify basic components of a tower crane.
6. Identify basic components of a gantry crane (rail-mounted).
7. Label positions of controls on a tower crane.
8. Label controls on a remote control unit.
9. Select from a list types of bridge cranes.
10. Select from a list types of tower cranes.
11. Select from a list types of gantry cranes.
12. Distinguish among standard hand signals used for cranes.
13. State safety rules related to bridge, tower, and gantry cranes.
14. State suggestions for effective bridge, tower, and gantry crane operation.
15. Demonstrate the ability to
    a. Perform a daily inspection on a tower crane.
    b. Service a gantry crane.

OBJECTIVE SHEET

c. Operate bridge crane controls.

d. Pick, move, and set load.

e. Hoist material from ground to top of structure, and unload.

f. Hoist an engine, set, and hold in position until installed.

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information, assignment, and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information and assignment sheets.

   E. Stress to students that manipulation of controls and operating procedures may differ with different models and different manufacturers.

   F. Stress to students the importance of safety devices and safety practices when operating equipment.

   G. Provide students with operator's guides and service guides for the particular equipment being used.

   H. Obtain and use material for reference, motivation, and complete study of the equipment.

   I. Demonstrate and discuss procedures outlined in job sheets.

   J. Provide other jobs if job sheets are not practical.

   K. Have students practice hand signals and use of controls until they become proficient.

   L. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment sheets

      1. Assignment Sheet #1--Label Positions of Controls on a Tower Crane

      2. Assignment Sheet #2--Distinguish Among Hand Signals

   E. Answers to assignment sheets

SUGGESTED ACTIVITIES

F. Job sheets

   1. Job Sheet #1--Perform a Daily Inspection on a Tower Crane

   2. Job Sheet #2--Service a Gantry Crane

   3. Job Sheet #3--Operate Bridge Crane Controls

   4. Job Sheet #4--Pick, Move, and Set Load

   5. Job Sheet #5--Hoist Material from Ground to Top of Structure, and Unload

   6. Job Sheet #6--Hoist an Engine, Set, and Hold in Position Until Installed

G. Test

H. Answers to test

III. Unit references

A. *Aerial Lifts.* Crane Inspection and Certification Bureau, Orlando, Florida: SGS Control Services, Inc., n.d.

B. *Crane Safety Training Manual.* Crane Inspection and Certification Bureau, Orlando, Florida: SGS Control Services, Inc., n.d.

C. Dickie, D.E. *Crane Handbook,* 1st ed. Toronto: Construction Safety Association of Ontario, 1975.

D. *Linden Tower Crane 5000: 451E.* Bridgeport, Connecticut: Linden-Alimak, 1976.

E. *Special Products Manual: Link-Belt® Cranes, Excavators, Diesel Pile Hammer.* Cedar Rapids, Iowa: FMC Corporation, Hydraulic Crane and Excavator Division, 1980.

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

INFORMATION SHEET

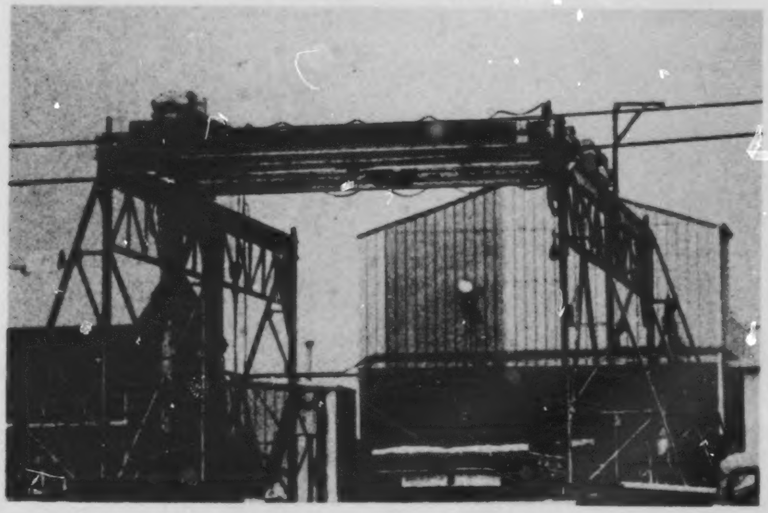
I. Uses of bridge, tower, and gantry cranes

(NOTE: Tower cranes are used for extreme heights and where 360° rotation is necessary.)

A. Bridge (overhead crane) (Figure 1)

1. Hoisting and moving equipment and materials
2. Loading equipment and materials
3. Hoisting and setting equipment

FIGURE 1

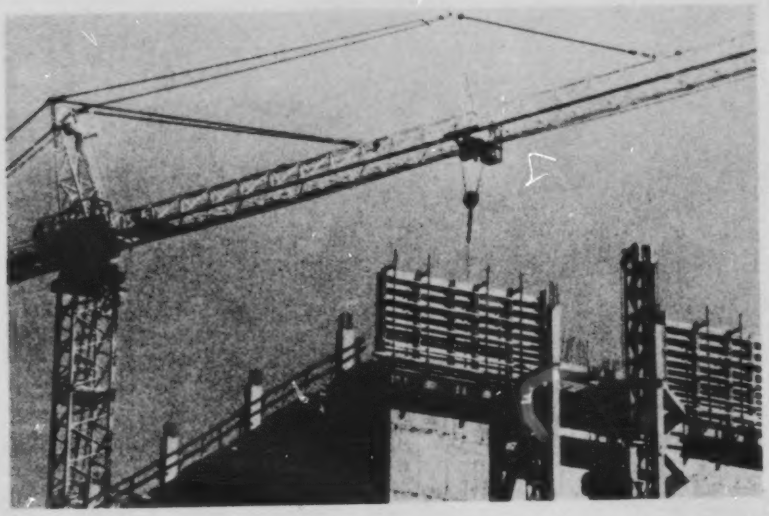


INFORMATION SHEET

B. Tower (Figure 2)

1. Handling materials
2. Placing concrete
3. Flying forms (moving large sections of concrete forms)

FIGURE 2

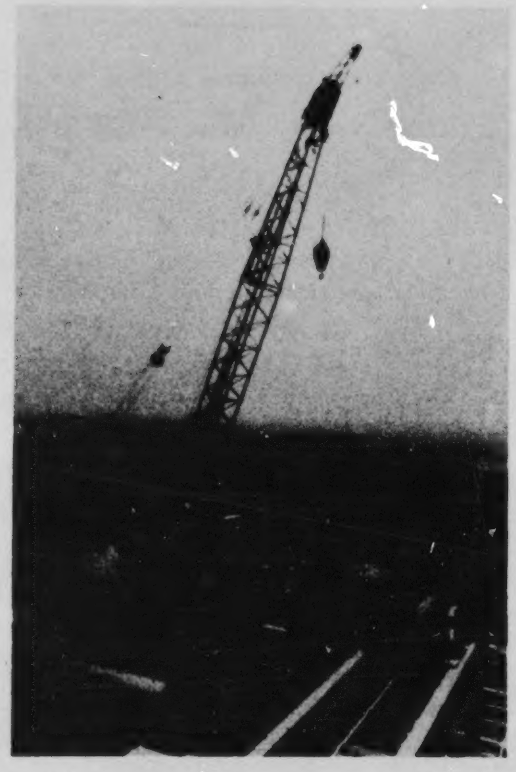


INFORMATION SHEET

C. Gantry (Figure 3)

1. Lifting heavy equipment and materials for large construction projects
2. Handling cargo for shipyards and docks
3. Handling materials for heavy construction projects, such as fossil fuel power plants and dams

FIGURE 3



II. Terms and definitions

A. Overhead crane--Machine for lifting, lowering, and transporting loads, consisting of a movable bridge carrying a fixed or movable hoisting mechanism and traveling on an overhead runway structure

B. Hoist--Mechanism for raising and lowering loads

C. Gantry--An overhead structure that supports machines or operating parts

D. Cantilever crane--Transport crane with one or both ends overhanging

INFORMATION SHEET

E. Magnet--An electromagnetic device carried on a crane hook to pick up loads

F. Trolley--Unit that travels on the bridge rails and carries the hoisting mechanism

G. Stops--Devices used to limit travel of a trolley or crane bridge

H. Tagline--Line attached to load to help balance and guide load while being hoisted

I. Controllers--Devices used by the operator to control the speed, acceleration, torque, and/or direction of motor-driven equipment

J. Work cycle--Complete set of operations performed before they are repeated

K. Hook block--Assembly including safety hook, bearing block, thrust bearing, brass bushing, and side weights

L. Sheave--Grooved wheel used to support cable and/or change its direction of travel

M. Maximum free-standing height--Distance from boom bottom to the ground

N. Maximum braced height--Distance from boom bottom to the ground with intermediate bracing

O. Auxiliary guys--Lines that help to steady tall structures

P. Available headroom--Distance between maximum height position of the hook to the uppermost work level

Q. Pendant--Fixed boom support cable

R. Remote control--Unit used to control indirectly or from a distance

S. Weather vane--To align boom with the direction the wind is blowing

T. Limit switch--Safety device on an electrically-driven lift, engine, or hoist

U. Trolley radius marker--Marker installed on the jib to inform the operator of the radius of the hook block

V. Pick load--Term used for hoisting load

W. Swivel--Device joining two parts so that one or both can pivot freely

X. Slewing--Rotation of a crane jib so the load moves horizontally through the arc

Y. Bearing floor--Floor or footing that the tower base is attached to

INFORMATION SHEET

Z. Torque--Turning or twisting force that determines tightness of bolts

AA. Jib--Extension piece hinged to the upper end of a crane boom

BB. Load chart--Information operator needs to determine the crane's capacity quickly and accurately

CC. Dead man control--Type of control that returns to neutral when released

DD. Bogie--Two-axle driving unit; also called *tandem*

EE. Counterweight--Dead or non-working load attached to one end of machine to balance weight carried on opposite end

FF. Two blocking--Pulling the hook block up against boom point sheave

III. Descriptions of bridge, tower, and gantry cranes

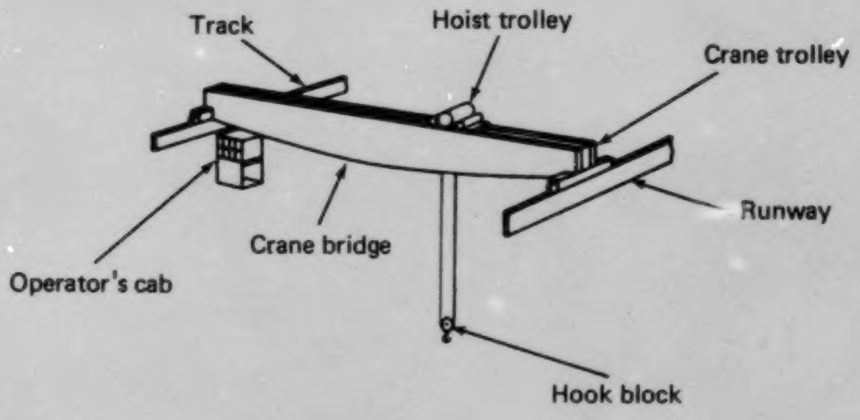
A. Bridge crane--Machine for lifting, lowering, and transporting loads, consisting of a movable bridge with a fixed or movable hoisting mechanism; travels on an overhead runway structure

B. Tower crane--Crane mounted on top of a tower; sometimes incorporated in the frame of a building

C. Gantry crane--Bridge-like hoisting machine with fixed supports or supports arranged for running along tracks

IV. Basic components of a bridge crane (Figure 4)

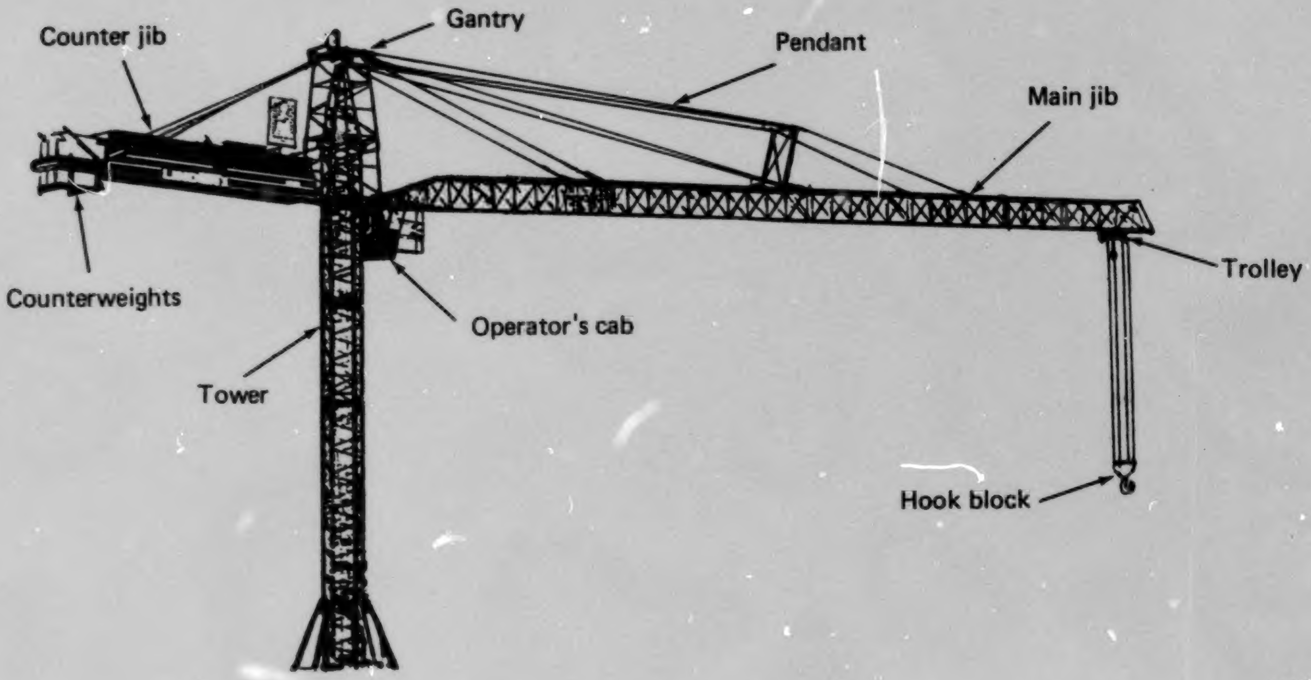
FIGURE 4



INFORMATION SHEET

V. Basic components of a tower crane (Figure 5)

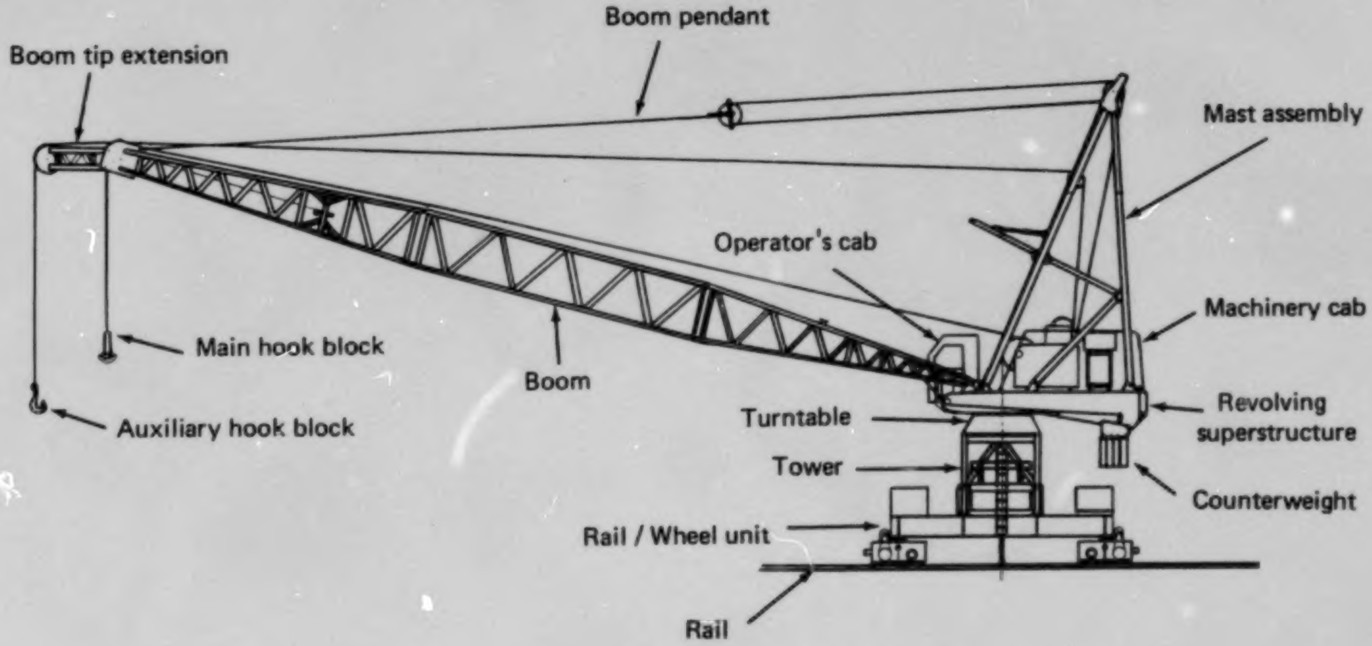
FIGURE 5


Counter jib
Gantry
Pendant
Main jib
Trolley
Counterweights
Operator's cab
Tower
Hook block

INFORMATION SHEET

VI. Basic components of a gantry crane (rail-mounted) (Figure 6)

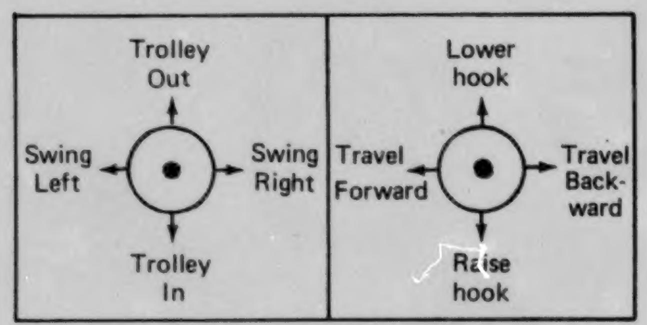
FIGURE 6


Boom pendant
Boom tip extension
Mast assembly
Operator's cab
Machinery cab
Main hook block
Boom
Revolving superstructure
Turntable
Auxiliary hook block
Tower
Counterweight
Rail / Wheel unit
Rail

INFORMATION SHEET

VII. Positions of controls on a tower crane (Figures 7 and 8; Assignment Sheet #1)

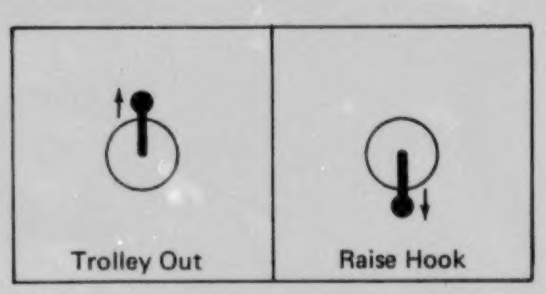
FIGURE 7


Trolley Out
Swing Left
Swing Right
Trolley In
Lower hook
Travel Forward
Travel Backward
Raise hook

Used with permission of the Construction Safety Association of Ontario.

EXAMPLE:

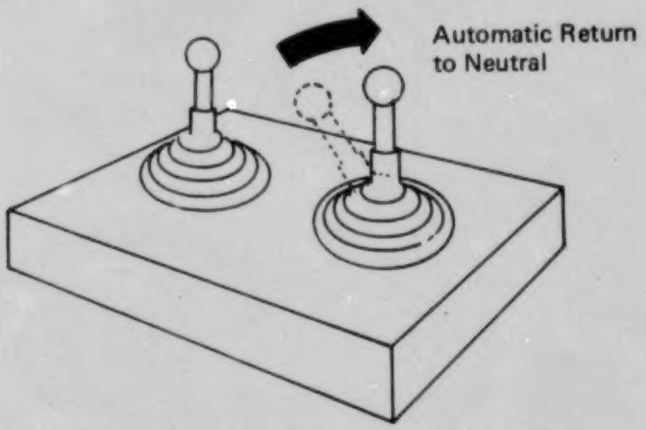
FIGURE 8


Trolley Out
Raise Hook

Used with permission of the Construction Safety Association of Ontario.

(NOTE: Every control should be of the "dead man" type and must be clearly marked; see Figure 9)

FIGURE 9


Automatic Return to Neutral

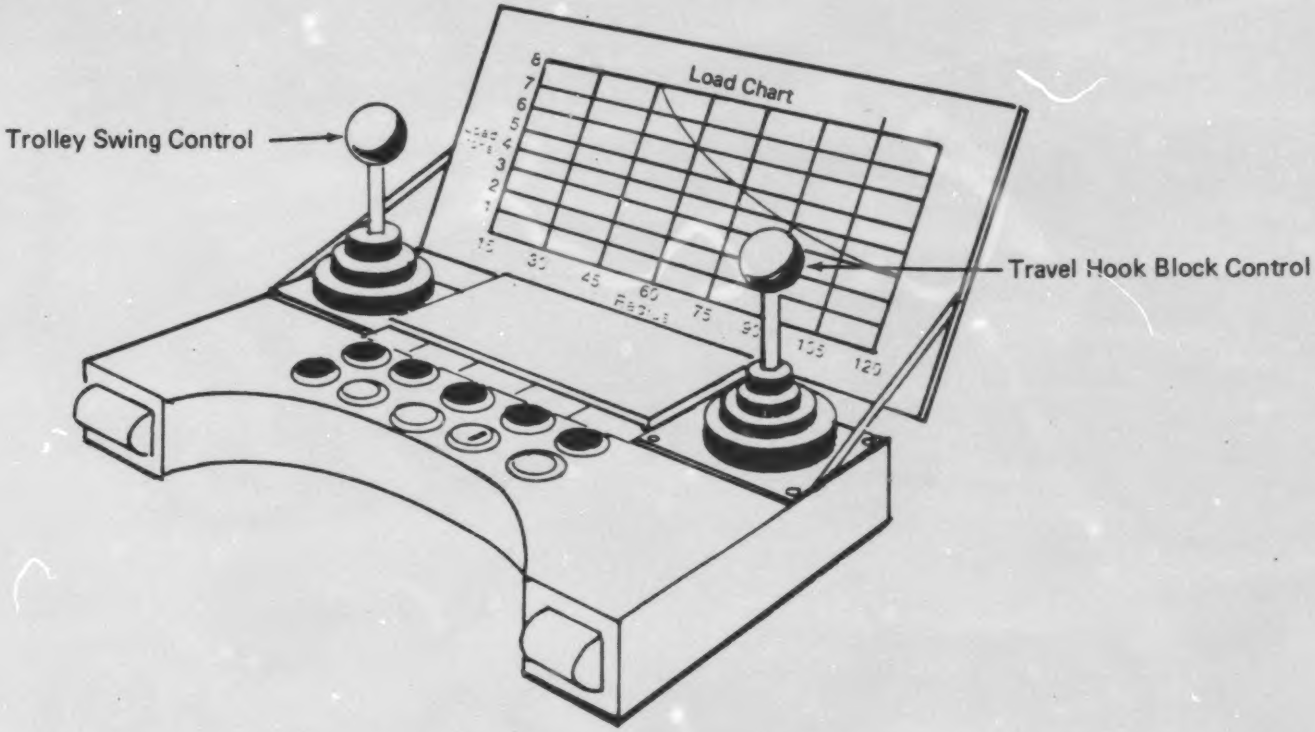
Used with permission of the Construction Safety Association of Ontario.

INFORMATION SHEET

VIII. Controls on a remote control unit (Figure 10)

(NOTE: Remote control unit must always include a load chart.)

FIGURE 10


Trolley Swing Control
Load Chart
8
7
6
5
Load tons
4
3
2
1
15
30
45
60
Radius
75
90
105
120
Travel Hook Block Control

Used with permission of the Construction Safety Association of Ontario.

INFORMATION SHEET

IX. Types of bridge cranes

  A. Overhead traveling

  B. Gantry

  C. Semi-gantry

  D. Cantilever gantry

  E. Wall crane

  F. Single-leg gantry

  G. Hand-pushed underhung

  H. Hammer-head crane

  I. Jib crane

X. Types of tower cranes

  A. Stationary tower crane (fixed tower)

  B. Stationary tower crane (slewing tower)

  C. Climbing crane (fixed tower)

  D. Climbing crane (slewing tower)

  (NOTE: In addition to being fixed or slewing, towers may also be classified as mono-towers, inner and outer towers, telescopic towers, or saddle jib towers.)

  E. Portable rail-mounted

  F. Crawler crane with tower

  G. Mobile base crane with tower

  H. Trailer-mounted tower

XI. Types of gantry cranes

  A. Gantry-mounted tower crane

  B. Rail-mounted tower/gantry

  C. Hydraulic climbing tower gantry crane

  D. Bogie-mounted tower crane

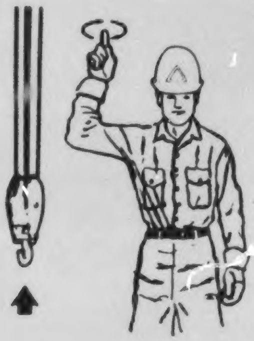
  E. Bogie-mounted crane

INFORMATION SHEET

XII. Standard hand signals used for cranes (Figures 11-27) (Assignment Sheet #2)

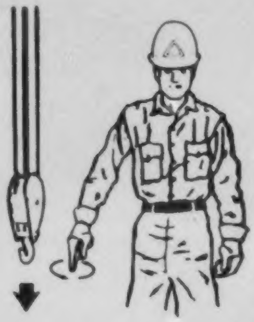
A. **Hoist**--Forearm vertical, forefinger pointing up; move hand in small horizontal circle

FIGURE 11



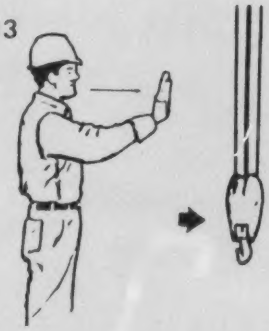
B. **Lower**--Arm extended downward, forefinger pointing down; move hand in small horizontal circle

FIGURE 12



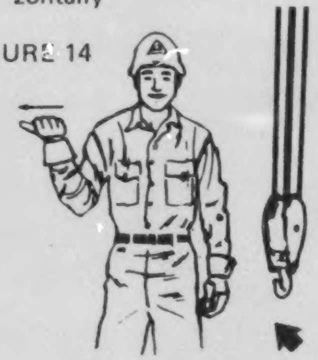
C. **Bridge travel**--Arm extended forward, hand opened and slightly raised; make pushing motion in direction of travel

FIGURE 13



D. **Trolley travel**--Palm up, fingers closed, thumb pointing in direction of motion; jerk hand horizontally

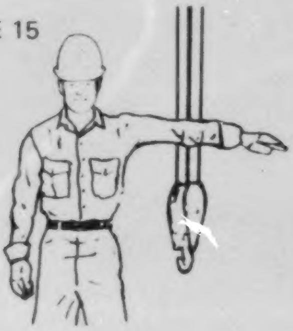
FIGURE 14



INFORMATION SHEET

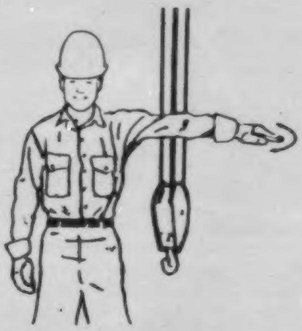
E. **Stop**--Arm extended, palm down; hold position rigidly

FIGURE 15



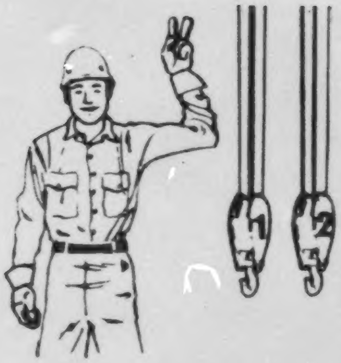
F. **Emergency stop**--Arm extended, palm down; move hand rapidly right and left

FIGURE 16



G. **Multiple trolleys**--One finger held up for block marked "1," and two fingers for block marked "2"; follow with regular signals

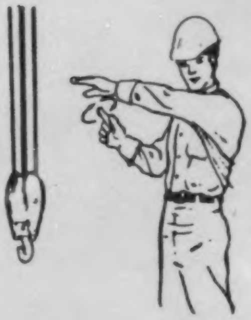
FIGURE 17



H. **Move slowly**--One hand used to give signal, other hand motionless in front of hand giving the motion signal

EXAMPLE: Hoist slowly

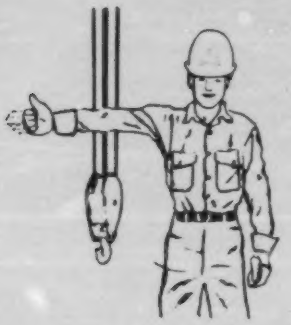
FIGURE 18



INFORMATION SHEET

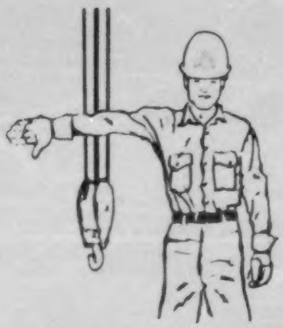
I. **Raise the boom and lower load**--Arm extended, thumb pointing up; flex fingers in and out as long as load movement is desired

FIGURE 19



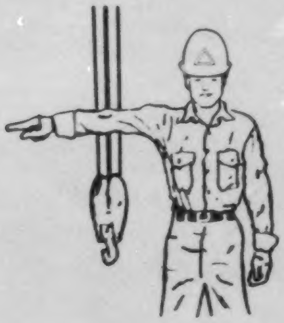
J. **Lower the boom and raise load**--Arm extended, thumb pointing down; flex fingers in and out as long as load movement is desired

FIGURE 20



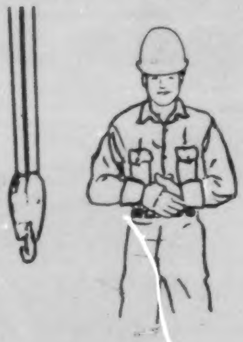
K. **Swing**--Arm extended, point with finger in direction of swing of boom

FIGURE 21



L. **Dog everything**--Clasp hands in front of body

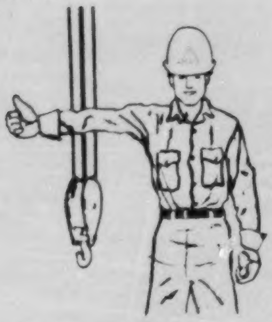
FIGURE 22



INFORMATION SHEET

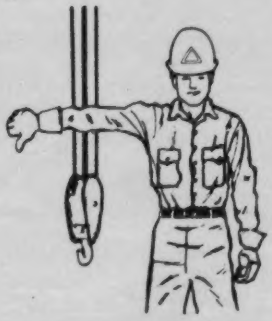
M. **Raise boom**--Arm extended, fingers closed; thumb pointing upward

FIGURE 23



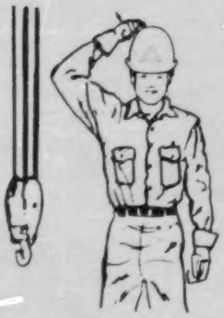
N. **Lower boom**--Arm extended, fingers closed; thumb pointing downward

FIGURE 24



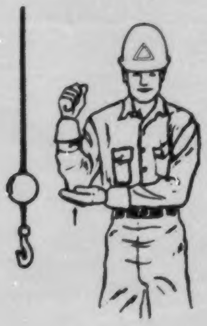
O. **Use main hoist**--Tap fist on head, then use regular signals

FIGURE 25



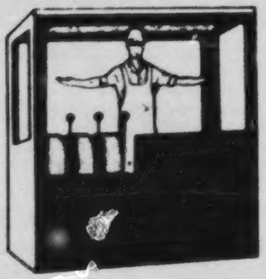
P. **Use whipline**--Tap elbow with one hand; then use regular signals

FIGURE 26



Q. **Magnet is disconnected**--Spread both hands apart, palms up

FIGURE 27



INFORMATION SHEET

XIII. Safety rules related to bridge, tower, and gantry cranes

A. Be sure cranes are grounded

B. Be sure all limit switches and safety devices are working properly

C. Be sure all safety guards are in place

D. Maintain at least ten feet between boom tip and nearest obstacle

E. Be sure trolley radius markers are installed on the jib

F. Never exceed lifting capacity of machine

G. Wear required protective items

H. Never leave controls with load suspended

I. Never allow anyone under a suspended load

J. Use taglines to help balance and control loads

K. Make sure that machine is clean

L. Be sure crane is equipped with a fire extinguisher

M. Do not operate crane in extremely high winds

N. Know, observe, and follow hand signals given by signal person

(NOTE: Obey stop signal at all times, regardless of who gives it.)

O. Check all controls for proper functioning before performing operations

P. Be sure an unattended crane will weathervane (tower crane)

Q. Never allow anyone to ride on crane or load

R. Always lock main switch in open position and tag before performing maintenance on equipment

S. Never trolley or travel without making certain no one will be endangered

T. If power goes off during operations, throw all controllers to the "off" position

U. Use anchors and/or fasteners on outdoor bridge cranes to secure them against wind forces

(NOTE: Knowledge of safety rules helps build good judgment in all situations.)

INFORMATION SHEET

XIV. Suggestions for effective bridge, tower, and gantry crane operation

(NOTE: The following are suggestions to help improve operating efficiency.)

A. Clear all unnecessary personnel from operating area

B. Do not do anything that will divert your attention while operating equipment

C. Know and respond to signals given by signal person

(NOTE: Obey stop signal at all times, regardless of who gives it.)

D. Service equipment regularly

E. Avoid jerky operations

F. Use taglines to help balance and control load

G. Set up work cycle so that it will be as short as possible

H. Avoid unnecessary booming and/or hoisting

I. Swing boom slowly to avoid throwing load outward or overswinging when machine stops

J. Before picking the load on capacity lifts, calculate and plan lifting cycle

K. Always set loads on firm, solid footing before releasing hitch

L. When figuring height of lift, sling-slack should be figured between hook and load, as well as block, hook, and boom deflection

M. Have adequate length of hoist rope for safe travel of hook block from highest to lowest point required with heavy loads

(NOTE: There must be at least three full wraps of rope on drum when hook is in lowest position.)

N. Raise load a few inches to verify balance and effectiveness of the braking system

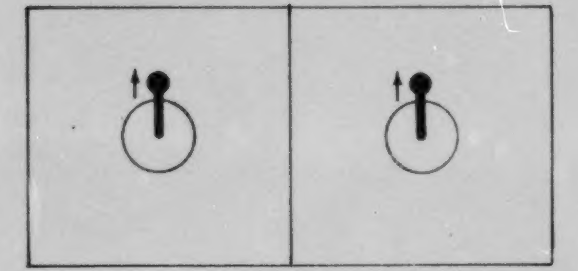
BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

ASSIGNMENT SHEET #1--LABEL POSITIONS OF CONTROLS ON A TOWER CRANE

NAME ______________________________ SCORE ____________________

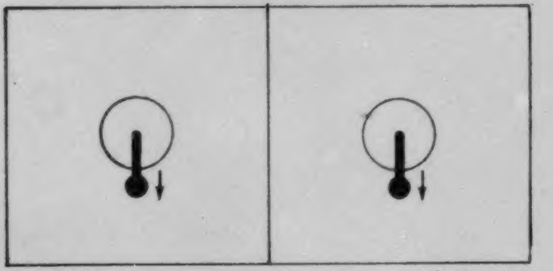
All controls should be installed so they will move in the direction of the resulting load or machine movement. This assignment sheet will help you become more familiar with the controls and how they operate before actually mounting a machine. Write the correct positions of controls on a tower crane in the blanks.

A.



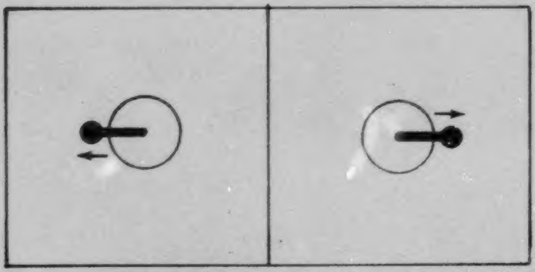
1. ____________________ 2. ____________________

B.



1. ____________________ 2. ____________________

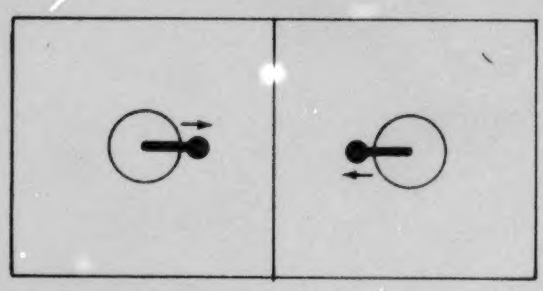
C.



1. ____________________ 2. ____________________

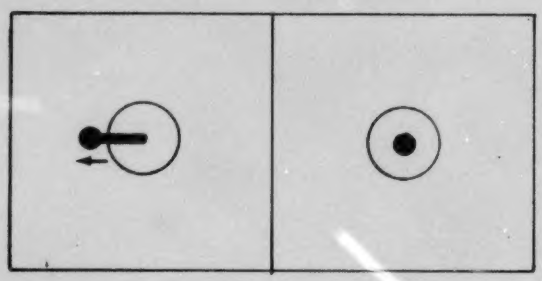
ASSIGNMENT SHEET #1

D.



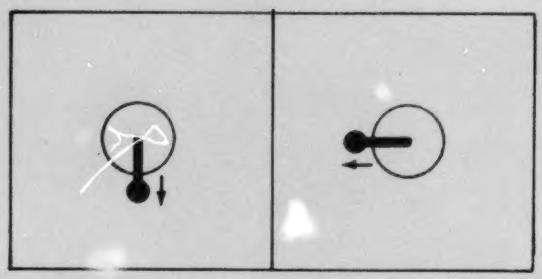
1. ____________________ 2. ____________________

E.



1. ____________________ 2. ____________________

F.



1. ____________________ 2. ____________________

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

ASSIGNMENT SHEET #2–DISTINGUISH AMONG HAND SIGNALS

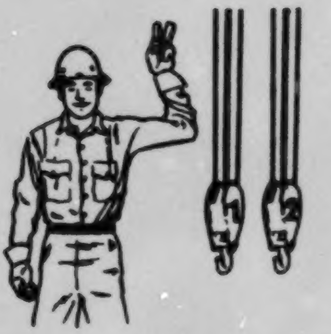
NAME ____ SCORE __________________

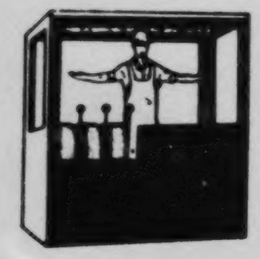
In crane operations it is very important to know how to use hand signals–by knowing them you may be able to help another worker get out of a bad situation and possibly avoid a serious accident.

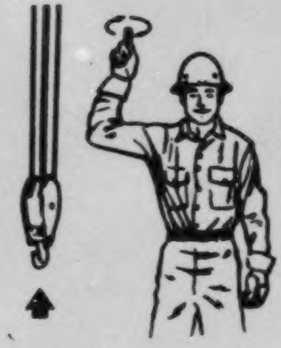
PART I

Distinguish among hand signals by writing an "X" under the correct illustration of each of the following hand signals.

A. Hoist

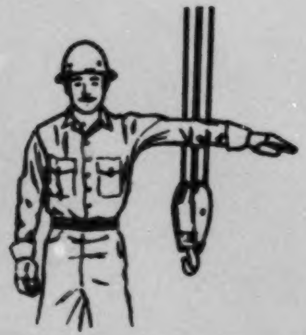


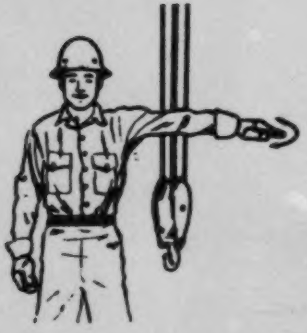


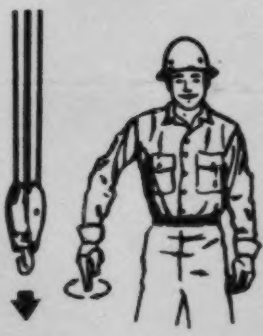


1. ________________ 2. ________________ 3. ________________

B. Lower



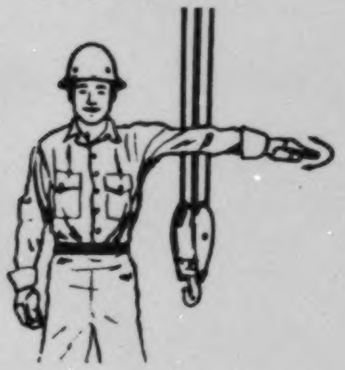




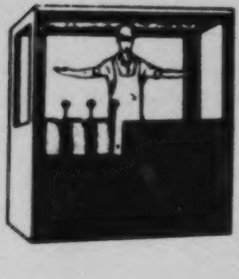
1. ________________ 2. ________________ 3. ________________

ASSIGNMENT SHEET #2

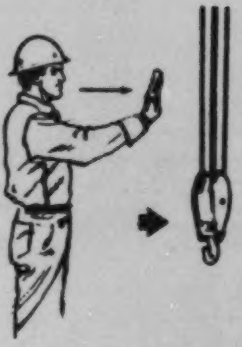
C. Emergency stop



1. ________________

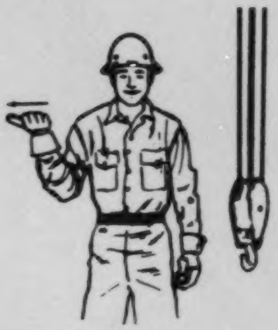


2. ________________

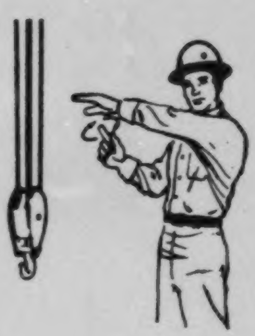


3. ________________

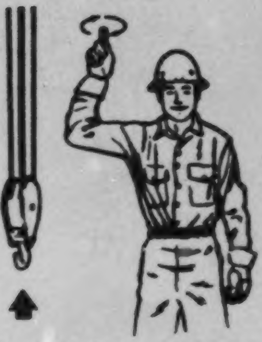
D. Move slowly



1. ________________

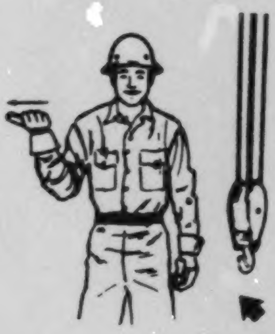


2. ________________

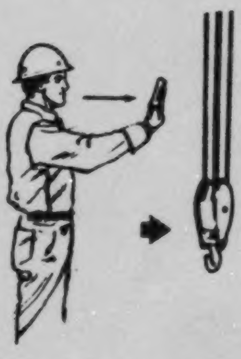


3. ________________

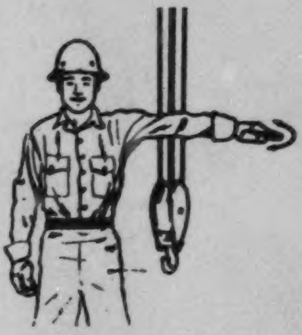
E. Trolley travel



1. ________________



2. ________________



3. ________________

ASSIGNMENT SHEET #2

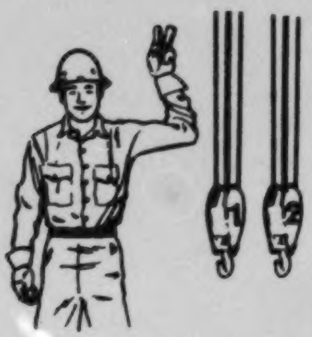
PART II

Write an "X" in the blank before the correct description of the hand signal shown in each illustration.

A. ______1. Magnet is disconnected

______2. Move slowly

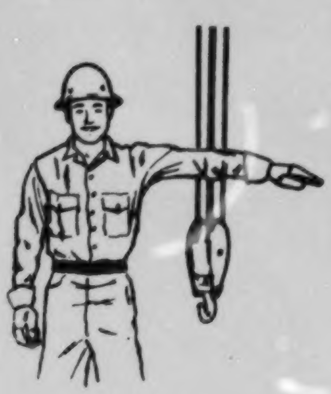
______3. Multiple trolleys



B. ______1. Bridge travel

______2. Stop

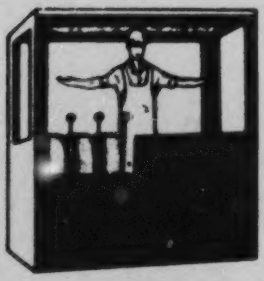
______3. Emergency stop



C. ______1. Magnet is disconnected

______2. Multiple trolley

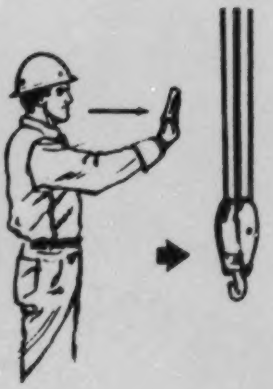
______3. Stop



D. ______1. Move slowly

______2. Trolley travel

______3. Bridge travel



BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 1. Trolley out
   2. Lower hook

B. 1. Trolley in
   2. Raise hook

C. 1. Swing left
   2. Travel backward

D. 1. Swing right
   2. Travel forward

E. 1. Swing left
   2. Neutral

F. 1. Trolley in
   2. Travel forward

Assignment Sheet #2

PART I	PART II
A. 3	A. 3
B. 3	B. 2
C. 1	C. 1
D. 2	D. 3
E. 1	

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

JOB SHEET #1--PERFORM A DAILY INSPECTION ON A TOWER CRANE

I. Equipment--Tower crane

II. Procedure

A. Check all wire ropes for condition and wear (including standing ropes)

B. Check all drums, sheaves, hooks, rigging hardware and attachments

C. Check all swivels to see that they rotate freely

D. Visually inspect boom and tower for straightness, and for signs of physical damage, such as cracking, bending, or other deformation

E. Look for cracking or flaking paint, indicating yielding of the metal

(NOTE: Every component of the tower and boom must be absolutely straight and free from dents.)

F. Be sure all exposed moving parts are guarded

G. Make sure that machine is clean

H. Check counterweight to be sure it is secure

I. Check adequacy of all shoring, bracing, and guy lines

J. Check tower support beams to be sure they are secure in the lateral direction

K. Check bearing floors for cracks

L. Check climbing units and ladders

M. Check wood tower wedges to be sure they are secure

N. Check torque on all tower, jib, and base bolts

(NOTE: When tightening tower bolts, slew the jib so that counterweight is over corner being tightened.)

O. Check slewing ring bolts, slewing rings, slewing gears, and gusset plates in tower ring for cracks

P. Check gear boxes for bolt tightness and oil leakage

JOB SHEET #1

Q. Check all drive belts for proper tension and wear

R. Check electrical cables to be sure they are free of obstacles and are not twisted or bent over sharp edges

S. Check cables for cuts, wear, and adequacy of terminals

T. Check all limit switches and safety devices for proper operation

U. Check for proper lubrication and proper oil levels in reservoirs

V. Visually inspect for fluid leaks

W. Inspect and test all brakes and clutches for proper adjustment and operation

X. Check all controls for proper operation

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

JOB SHEET #2--SERVICE A GANTRY CRANE

I. Equipment and materials

- A. Gantry crane
- B. Tool kit
- C. Grease gun
- D. Lubricants
- E. Cleaning solvents
- F. Hydraulic fluid and pouring spout
- G. Shop rags
- H. Belt tension gauge

II. Procedure

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Walk around equipment and visually inspect structural components for broken, worn, loose, or missing parts

(NOTE: Items found damaged, worn, or missing should be reported and repaired.)

B. Check all electrical wires and connectors; replace or repair as required

C. Inspect electrical system and safety devices to be sure they are functioning properly

D. Visually inspect hydraulic system for leaks

E. Check hydraulic reservoir; add fluid if needed

F. Remove filters, clean, then reinstall; replace with new filter if necessary

G. Check brakes and clutches for wear and adjustment; adjust if necessary

H. Check drive belts for wear and adjustment; replace or adjust if necessary

I. Clean and lubricate all grease fittings

(NOTE: Refer to manufacturer's service chart and/or maintenance manual for proper lubricants.)

JOB SHEET #2

J. Check all drums and cables for proper adjustment and wear; adjust and lubricate if necessary

K. Check trolley and hook block assembly

L. Check all anchors and/or tower wedges at each floor; tighten or adjust as necessary

M. Clean equipment

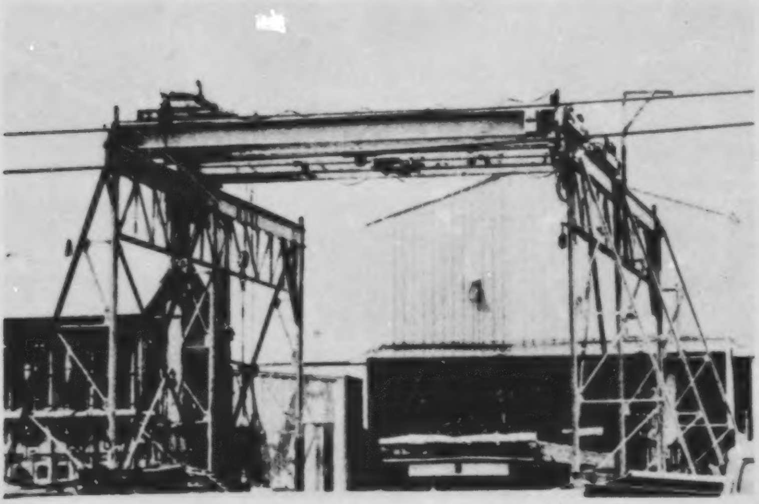
N. Check all controls for proper operation; make necessary repairs and/or adjustments

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

JOB SHEET #3--OPERATE BRIDGE CRANE CONTROLS

I. Equipment--Overhead traveling bridge crane (Figure 28)

FIGURE 28



II. Procedure

A. Engage trolley control to run trolley out to about center

B. Engage bridge control and move to opposite end against the stops

C. Engage bridge control and move about halfway back to starting point

D. Engage control to run trolley out about three quarters of distance across

E. Engage hoist control to lower hook block to the floor

F. Engage hoist control to raise hook block just enough to clear all obstacles

G. Engage trolley control to run back to center

H. Engage bridge control and move about halfway along runway

I. Engage hoist control to lower hook block to the floor

J. Manipulate controls to return all units back to original positions

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

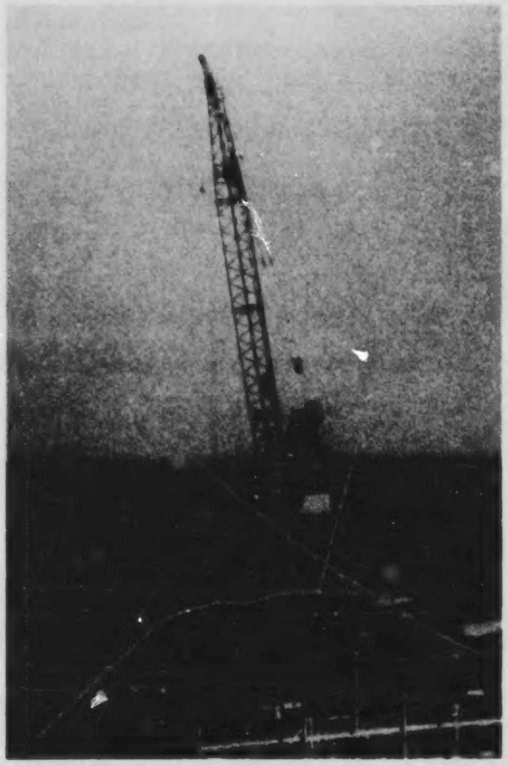
JOB SHEET #4--PICK, MOVE, AND SET LOAD

I. Equipment and materials

A. Gantry mounted tower crane (Figure 29)

B. Load

FIGURE 29



II. Procedure

A. Engage boom control to lower boom about 30 degrees

B. Disengage boom control

C. Engage swing control to swing boom to the right over load

D. Disengage swing control

JOB SHEET #4

E. Engage hoist control to lower hook block to load

(NOTE: At this point the ground crew will attach hook block to the load.)

F. Engage hoist control to raise load

(NOTE: Be sure tagline is being used.)

G. Raise load just enough to clear all obstacles

H. Disengage hoist control

I. Engage swing control to swing load to the right; at the same time, engage boom control to raise boom so that load will center over designated area

J. Disengage swing control and boom control

K. Engage hoist control to lower load to the deck

L. Disengage hoist control

(NOTE: At this point ground crew will remove hook block from the load.)

M. Engage swing control to swing left, back to loading position, and repeat cycle until job is completed

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

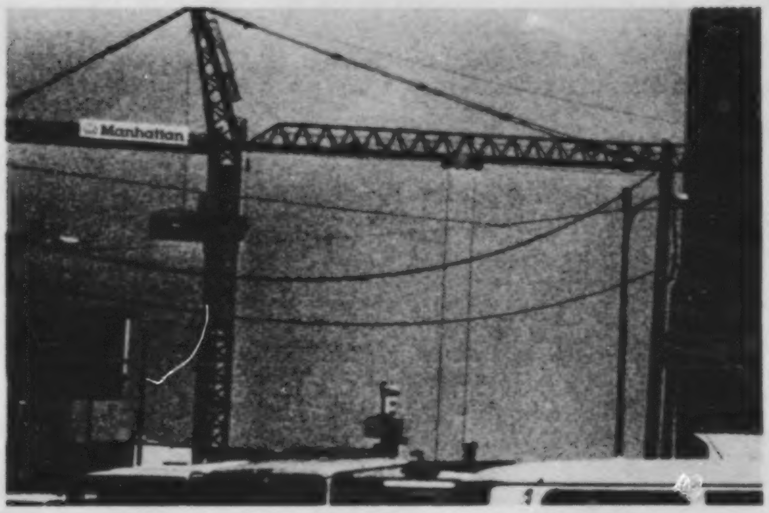
JOB SHEET #5--HOIST MATERIAL FROM GROUND TO TOP OF STRUCTURE, AND UNLOAD

I. Equipment and material

   A. Tower crane (climbing) with hook block (Figure 30)

   B. Load

   FIGURE 30



II. Procedure

   A. Position boom and trolley so that hook block can be lowered to the ground

   B. Engage control to lower hook block to the ground

   C. Adjust boom, trolley, and hoist line to center over load

   (NOTE: At this time, the load will be connected to the hook block by the ground crew.)

   D. Engage control to hoist load to top of building

   E. Raise load just enough to clear obstacles on top of building

   (NOTE: Be sure tagline is used to help balance load.)

JOB SHEET #5

F. Engage control to trolley load into approximate radii

G. Engage control to swing boom to the right until it is centered over unloading location

H. Readjust trolley so that it is centered over unloading location

I. Engage control to lower load to the proper location

(NOTE: Load will be disconnected by ground crew.)

J. Engage control to raise hook block just enough to clear all obstacles; at the same time, trolley out so hook block will clear building when lowered

K. Swing boom back to original location and lower hook block back to ground for another load

L. Repeat this cycle until job is completed

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

JOB SHEET #6--HOIST AN ENGINE, SET, AND HOLD IN POSITION UNTIL INSTALLED

I. Equipment

   A. Overhead crane

   B. Engine part

II. Procedure

   A. Engage bridge control to move bridge to opposite end to pick up engine

   B. Engage trolley control to center trolley over engine

   C. Engage hoist control and lower to engine

   (NOTE: It may be necessary to adjust trolley and hoist so they will center exactly over engine.)

   D. Connect hook block to engine

   E. Engage hoist control and raise engine a few inches to verify balance and effectiveness of the braking system

   F. Engage hoist control again and this time raise engine just enough to clear all obstacles

   G. Engage bridge control and move bridge to location where engine will be installed

   H. Engage trolley to move trolley so that engine will center over the correct installation point

   I. Engage hoist and lower engine so that it is just above the installation point

   (NOTE: It may be necessary to adjust bridge and trolley so that engine is in the exact location to be lowered to the installation point.)

   J. Lower engine until it is in the exact point for installation

   K. Hold engine in this position until it is completely hooked up and will support itself

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. List two uses for each of the following cranes.

   a. Bridge (overhead crane)

      1) ______________________________

      2) ______________________________

   b. Tower

      1) ______________________________

      2) ______________________________

   c. Gantry

      1) ______________________________

      2) ______________________________

2. Match terms associated with bridge, tower, and gantry cranes to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the following pages.

_____a. Machine for lifting, lowering, and transporting loads, consisting of a movable bridge carrying a fixed or movable hoisting mechanism and traveling on an overhead runway structure

_____b. Mechanism for raising and lowering loads

_____c. An overhead structure that supports machines or operating parts

_____d. Transport crane with one or both ends overhanging

_____e. An electromagnetic device carried on a crane hook to pick up loads

_____f. Unit that travels on the bridge rails and carries the hoisting mechanism

_____g. Device used to limit travel of a trolley or crane bridge

_____h. Line attached to load to help balance and guide load while being hoisted

1. Gantry
2. Stops
3. Magnet
4. Hoist
5. Cantilever crane
6. Trolley
7. Overhead crane
8. Tagline

TEST

______i. Devices used by the operator to control the speed, acceleration, torque, and/or direction of motor-driven equipment

______j. Complete set of operations performed before they are repeated

______k. Assembly including safety hook, bearing block, thrust bearing, brass bushing, and side weights

______l. Grooved wheel used to support cable and/or change its direction of travel

______m. Distance from boom bottom to the ground

______n. Distance from boom bottom to the ground with intermediate bracing

______o. Lines that help to steady tall structures

______p. Distance between maximum height position of the hook to the uppermost work level

______q. Fixed boom support cable

______r. Unit used to control indirectly or from a distance

______s. To align boom with the direction the wind is blowing

______t. Safety device on an electrically-driven lift, engine, or hoist

______u. Marker installed on the jib to inform the operator of the radius of the hook block

______v. Term used for hoisting load

______w. Device joining two parts so that one or both can pivot freely

______x. Rotation of a crane jib so the load moves horizontally through the arc

______y. Floor or footing that the tower base is attached to

______z. Turning or twisting force that determines tightness of bolts

______aa. Extension piece hinged to the upper end of a crane boom

9. Hook block
10. Auxiliary guys
11. Remote control
12. Trolley radius marker
13. Swivel
14. Available headroom
15. Sheave
16. Torque
17. Slewing
18. Weather vane
19. Maximum free-standing height
20. Controllers
21. Pendant
22. Pick load
23. Bearing floor
24. Work cycle
25. Limit switch
26. Maximum braced height
27. Jib

TEST

_____bb. Information operator needs to determine the crane's capacity quickly and accurately

_____cc. Type of control that returns to neutral when released

_____dd. Two-axle driving unit; also called *tandem*

_____ee. Dead or non-working load attached to one end of machine to balance weight carried on opposite end

_____ff. Pulling the hook block up against boom point sheave

28. Two blocking
29. Load chart
30. Counterweight
31. Bogie
32. Dead man control

3. Match bridge, tower, and gantry cranes to their correct descriptions. Write the correct numbers in the blanks.

_____a. Crane mounted on top of a tower; sometimes incorporated in the frame of a building

_____b. Bridge-like hoisting machine with fixed supports or supports arranged for running along tracks

_____c. Machine for lifting, lowering, and transporting loads, consisting of a movable bridge with a fixed or movable hoisting mechanism; travels on an overhead runway structure

1. Bridge crane
2. Tower crane
3. Gantry crane

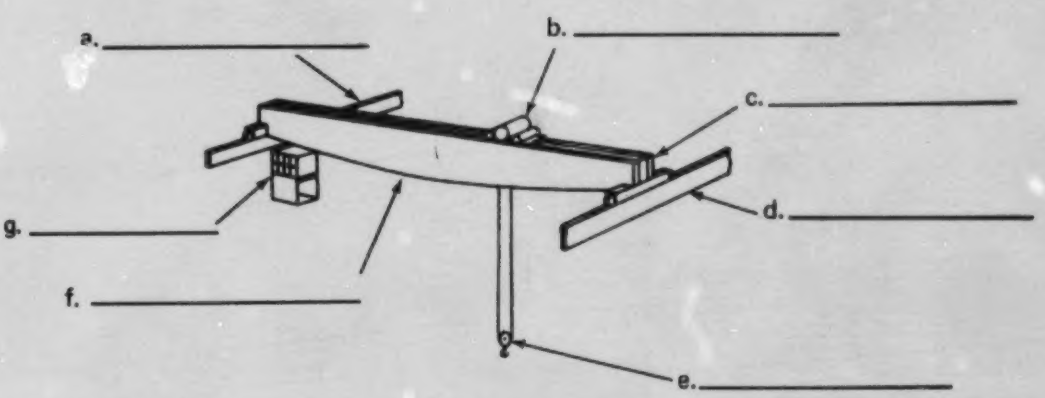
4. Identify basic components of a bridge crane. Write the correct names in the blanks.

Runway

Track
Hook block

Crane trolley
Operator's cab

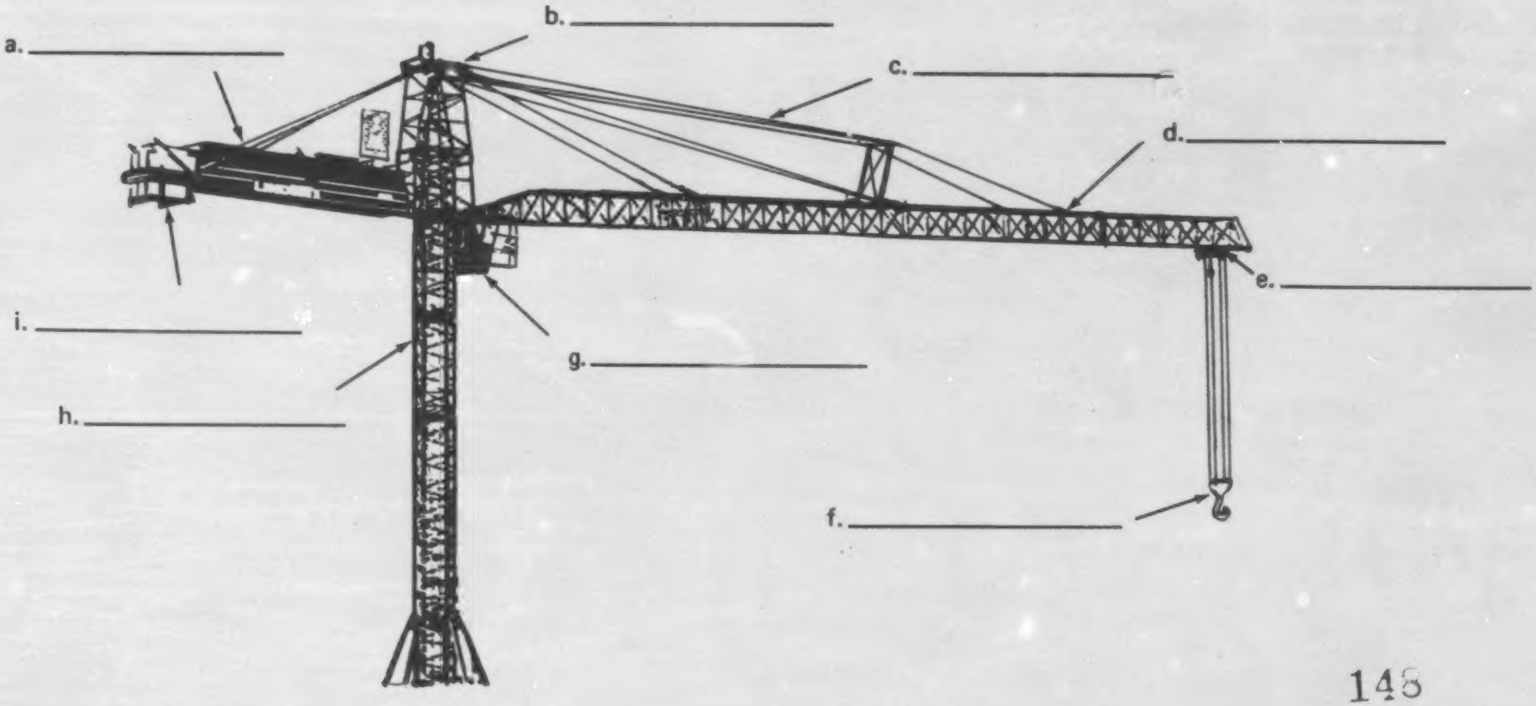
Hoist trolley
Crane bridge



TEST

5. Identify basic components of a tower crane. Write the correct names in the blanks.

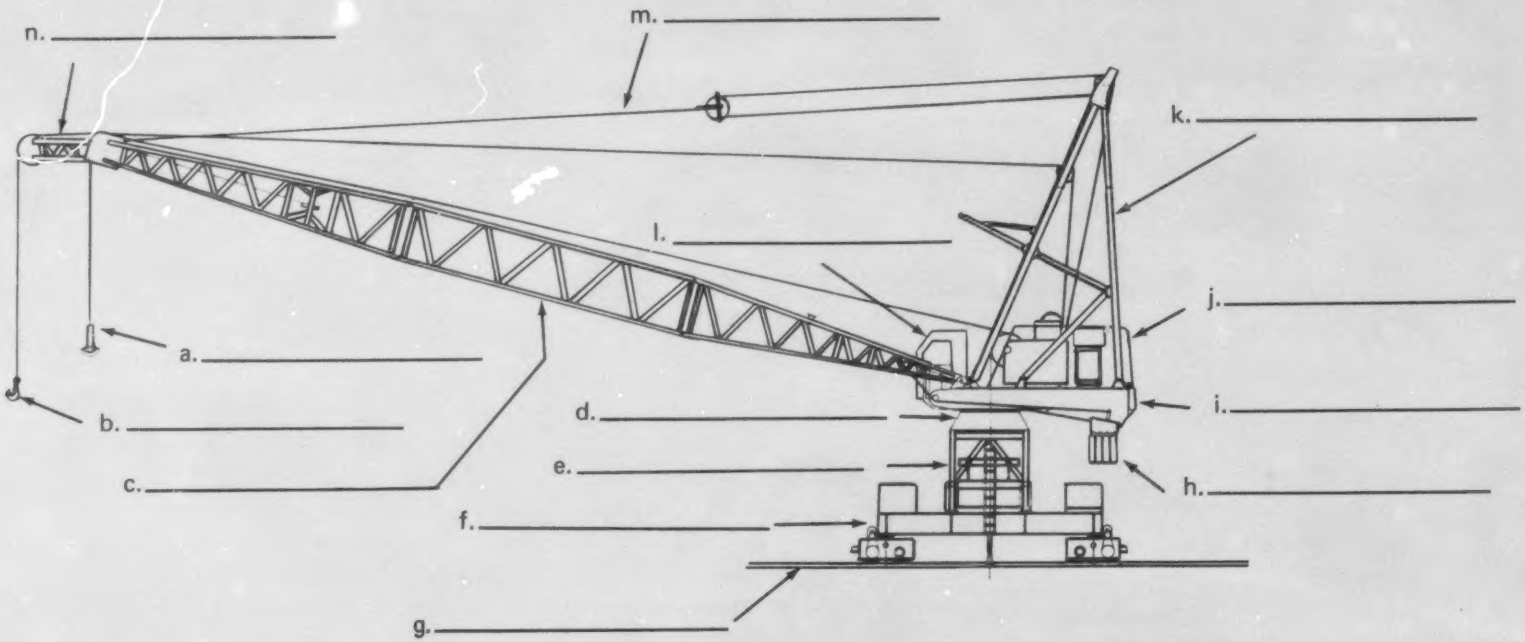
Hook block
Tower
Counterweights
Pendant
Gantry
Main jib
Counter jib
Operator's cab
Trolley



TEST

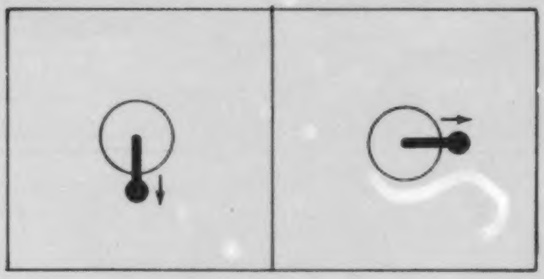
6. Identify basic components of a gantry crane (rail-mounted). Write the correct names in the blanks.

Machinery cab
Operator's cab
Turntable
Counterweight
Tower
Boom
Rail
Boom pendant
Mast assembly
Rail/wheel unit
Boom tip extension
Revolving superstructure
Auxiliary hook block
Main hook block

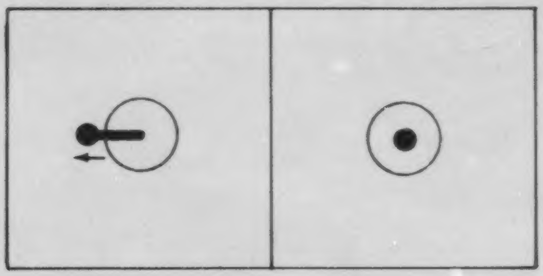


TEST

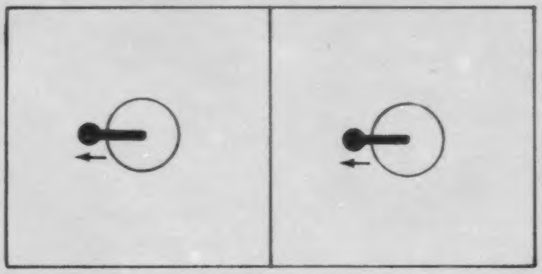
7. Label positions of the controls on a tower crane. Write the correct answers in the blanks.



a. ______________________ b. ______________________



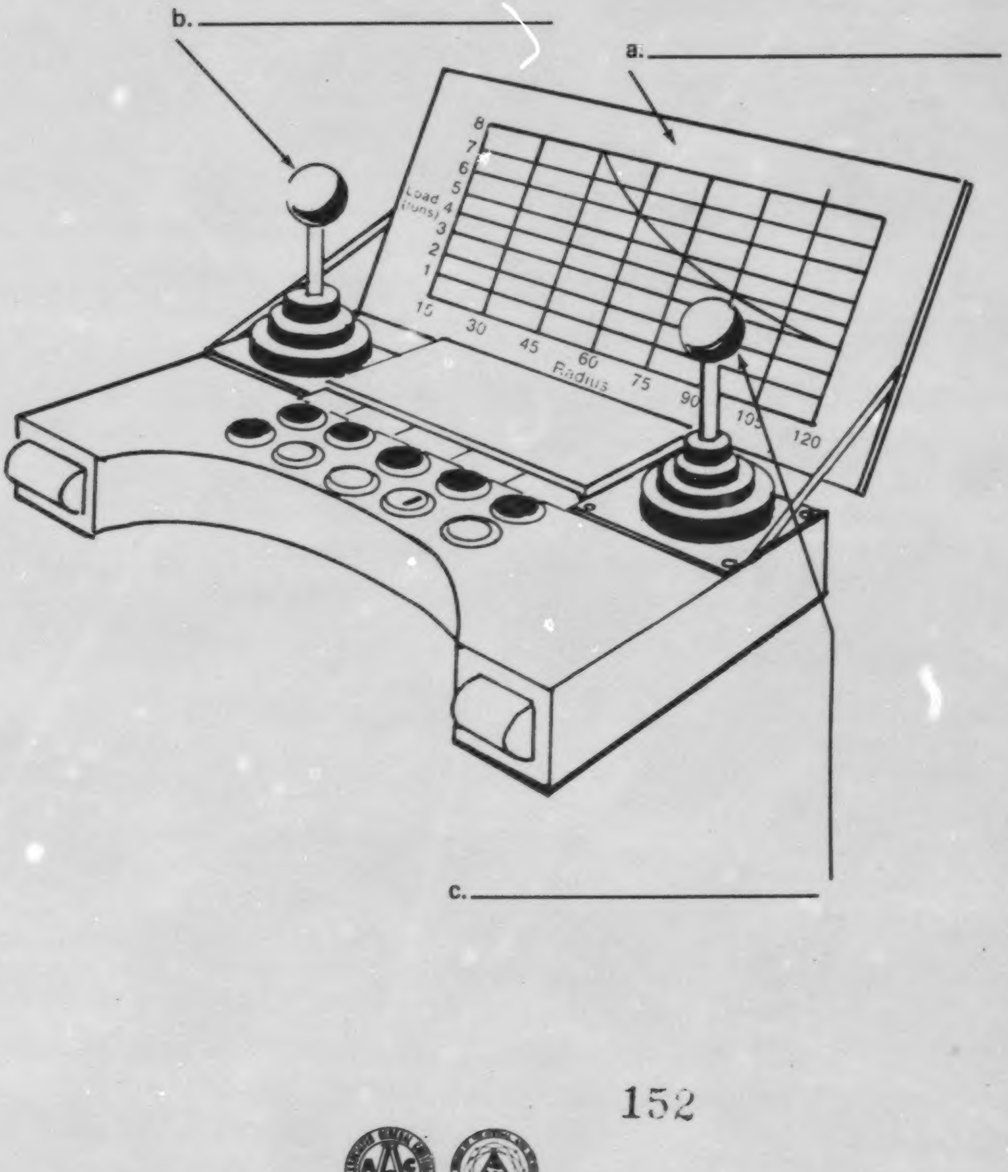
c. ______________________ d. ______________________



e. ______________________ f. ______________________

TEST

8. Label controls on a remote control unit. Write the correct names in the blanks.


b. ____________
a. ____________
8
7
6
5
4
3
2
1
Load (tons)
15
30
45
60
75
90
105
120
Radius
c. ____________

TEST

9. Select from the following list types of bridge cranes. Write an "X" in the blank before each correct answer.

_____a. Bogie-mounted crane
_____b. Wall crane
_____c. Cantilever gantry
_____d. Rail-mounted tower gantry
_____e. Semi-gantry
_____f. Overhead traveling
_____g. Monorail carrier
_____h. Gantry

10. Select from the following list types of tower cranes. Write an "X" in the blank before each correct answer.

_____a. Climbing crane (slewing tower)
_____b. Mobile base crane with tower
_____c. Rail-mounted tower gantry
_____d. Portable rail-mounted
_____e. Stationary tower crane (fixed tower)
_____f. Overhead traveling
_____g. Trailer-mounted tower
_____h. Climbing crane (fixed tower)

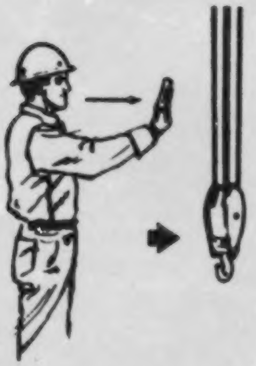
11. Select from the following list types of gantry cranes. Write an "X" in the blank before each correct answer.

_____a. Overhead traveling
_____b. Rail-mounted tower/gantry
_____c. Portable rail-mounted
_____d. Bogie-mounted crane
_____e. Crawler crane with tower
_____f. Bogie-mounted tower crane
_____g. Gantry-mounted tower crane
_____h. Hydraulic climbing tower gantry crane

TEST

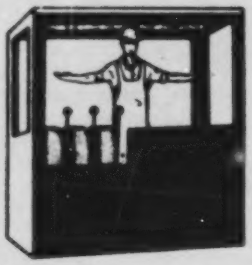
12. Distinguish among standard hand signals used for cranes. Write an "X" in the blank under the correct description and illustration of each of the hand signals indicated.

a. **Lower**



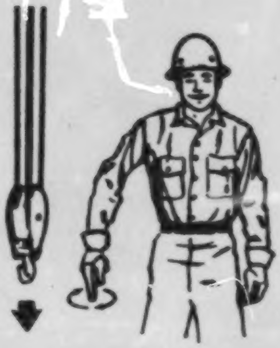
Arm extended forward, hand opened and slightly raised; make pushing motion in direction of travel

1) ______________



Both hands spread apart, palms up

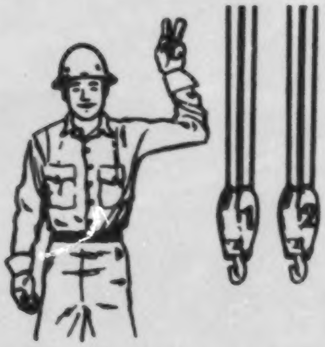
2) ______________



Arm extended downward, forefinger pointing down; move hand in small horizontal circle

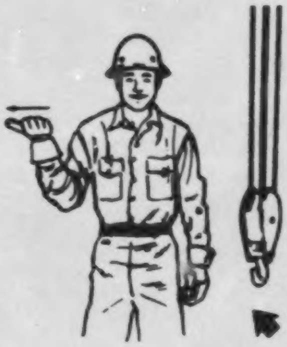
3) ______________

b. **Emergency stop**



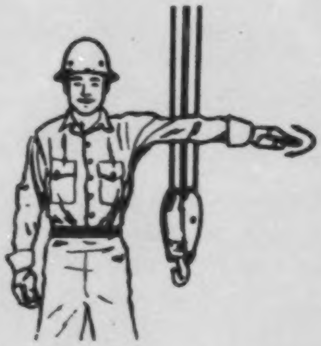
One finger held up for block marked "1," and two fingers for block marked "2"; follow with regular signals

1) ______________



Palm up, fingers closed, thumb pointing in direction of motion; jerk hand horizontally

2) ______________

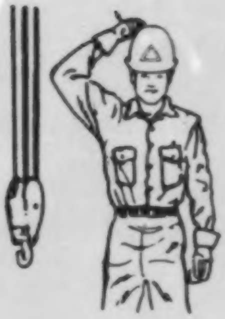


Arm extended, palm down; move hand rapidly right and left

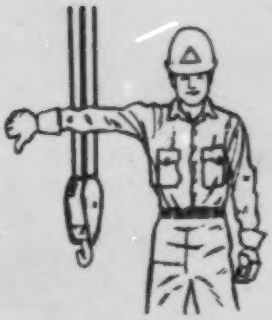
3) ______________

TEST

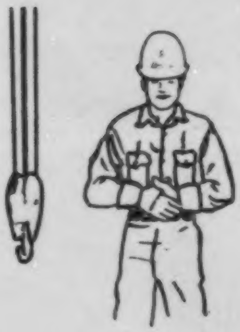
c. **Lower boom**



Tap fist on head then use regular signals



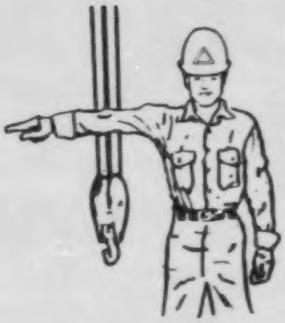
Arm extended, fingers closed; thumb pointing downward



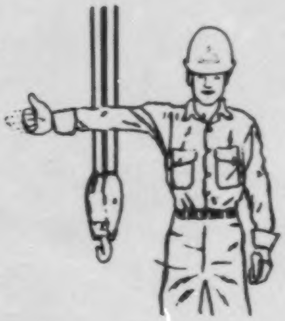
Clasp hands in front of body

1) ______________ 2) ______________ 3) ______________________

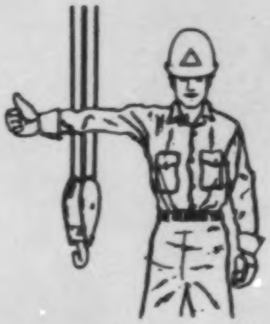
d. **Raise the boom and lower load**



Arm extended, point with finger in direction of swing of boom



Arm extended, thumb pointing up; flex fingers in and out as long as load movement is desired

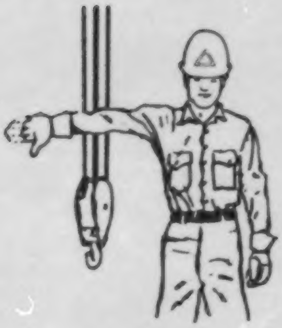


Arm extended, fingers closed, thumb pointing upward

1) ______________ 2) ______________ 3) ______________________

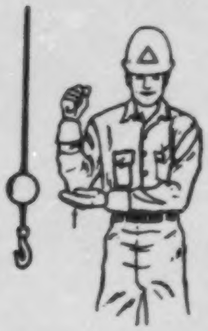
TEST

e. **Lower the boom and raise load**



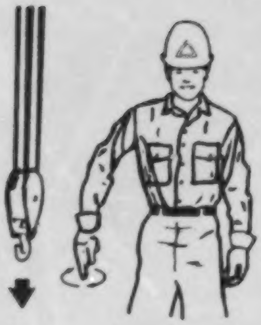
Arm extended, thumb pointing down; flex fingers in and out as long as load movement is desired

1) ____________



Tap elbow with one hand; then use regular signals

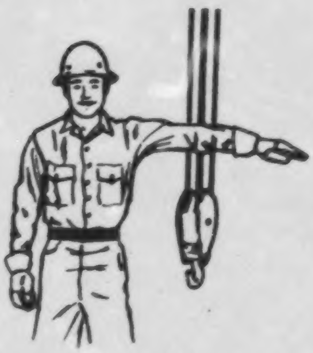
2) ____________



Arm extended downward, forefinger pointing down; move hand in small, horizontal circle

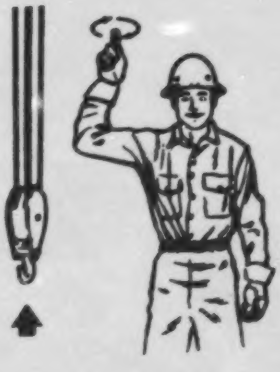
3) ____________

f. **Move slowly**



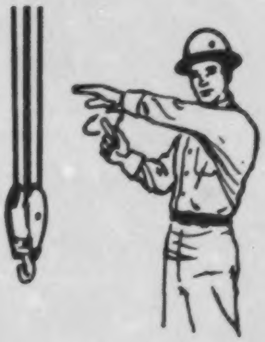
Arm extended, palm down; hold position rigidly

1) ____________



Forearm vertical, forefinger pointing up; move hand in small horizontal circle

2) ____________



One hand used to give signal, other hand motionless in front of hand giving the motion signal

3) ____________

TEST

13. State ten safety rules related to bridge, tower, and gantry cranes.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

14. State eight suggestions for effective bridge, tower, and gantry crane operations.

a. ______________________________

b. ______________________________

TEST

c.

d.

e.

f.

g.

h.

(NOTE: Test question 15 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

15. Demonstrate the ability to

    a. Perform a daily inspection on a tower crane.

    b. Service a gantry crane.

    c. Operate bridge crane controls.

    d. Pick, move, and set load.

    e. Hoist material from ground to top of structure, and unload.

    f. Hoist an engine, set, and hold in position until installed.

BRIDGE, TOWER, AND GANTRY CRANES
UNIT III

ANSWERS TO TEST

1. Answer should include two of the following in each category

   a. Bridge (overhead crane)

      1) Hoisting and moving equipment and materials
      2) Loading equipment and materials
      3) Hoisting and setting equipment

   b. Tower

      1) Handling materials
      2) Placing concrete
      3) Flying forms (moving large sections of concrete forms)

   c. Gantry

      1) Lifting heavy equipment and materials for large construction projects
      2) Handling cargo for shipyards and docks
      3) Handling material for heavy construction projects, such as fossil fuel power plants and dams

2.

a.	7	l.	15	w.	13
b.	4	m.	19	x.	17
c.	1	n.	26	y.	23
d.	5	o.	10	z.	16
e.	3	p.	14	aa.	27
f.	6	q.	21	bb.	29
g.	2	r.	11	cc.	32
h.	8	s.	18	dd.	31
i.	20	t.	25	ee.	30
j.	24	u.	12	ff.	28
k.	9	v.	22		

ANSWERS TO TEST

3. a. 2
b. 3
c. 1

4. a. Track
b. Hoist trolley
c. Crane trolley
d. Runway
e. Hook block
f. Crane bridge
g. Operator's cab

5. a. Counter jib
b. Gantry
c. Pendant
d. Main jib
e. Trolley
f. Hook block
g. Operator's cab
h. Tower
i. Counterweights

6. a. Main hook block
b. Auxiliary hook block
c. Boom
d. Turntable
e. Tower
f. Rail/wheel unit
g. Rail
h. Counterweight
i. Revolving superstructure
j. Machinery cab
k. Mast assembly
l. Operator's cab
m. Boom pendant
n. Boom tip extension

7. a. Trolley in
b. Travel backward
c. Swing left
d. Neutral
e. Swing left
f. Travel forward

8. a. Load chart
b. Trolley swing control
c. Travel/hook block control

ANSWERS TO TEST

9. b, c, e, f, h

10. a, b, d, e, g, h

11. b, d, f, g, h

12. a. 3 d. 2
    b. 3 e. 1
    c. 2 f. 3

13. Answer should include any ten of the following

    a. Be sure cranes are grounded
    b. Be sure all limit switches and safety devices are working properly
    c. Be sure all safety guards are in place
    d. Maintain at least ten feet between boom tip and nearest obstacle
    e. Be sure trolley radius markers are installed on the jib
    f. Never exceed lifting capacity of machine
    g. Wear required protective items
    h. Never leave controls with load suspended
    i. Never allow anyone under a suspended load
    j. Use taglines to help balance and control loads
    k. Make sure that machine is clean
    l. Be sure crane is equipped with a fire extinguisher
    m. Do not operate crane in extremely high winds
    n. Know, observe, and follow hand signals given by signal person
    o. Check all controls for proper functioning before performing operations
    p. Be sure an unattended crane will weathervane (tower crane)
    q. Never allow anyone to ride on crane or load

ANSWERS TO TEST

r. Alway lock main switch in open position and tag before performing maintenance on equipment

s. Never trolley or travel without making certain no one will be endangered

t. If power goes off during operations, throw all controllers to the "off" position

u. Use anchors and/or fasteners on outdoor bridge cranes to secure them against wind forces

14. Answer should include any eight of the following

a. Clear all unnecessary personnel from operating area

b. Do not do anything that will divert your attention while operating equipment

c. Know and respond to signals given by signal person

d. Service equipment regularly

e. Avoid jerky operations

f. Use taglines to help balance and control load

g. Set up work cycle so that it will be as short as possible

h. Avoid unnecessary booming and/or hoisting

i. Swing boom slowly to avoid throwing load outward or overswinging when machine stops

j. Before picking the load on capacity lifts, calculate and plan lifting cycle

k. Always set loads on firm, solid footing before releasing hitch

l. When figuring height of lift, sling-slack should be figured between hook and load, as well as block, hook, and boom deflection

m. Have adequate length of hoist rope for safe travel of hook block from highest to lowest point required with heavy loads

n. Raise load a few inches to verify balance and effectiveness of the braking system

15. Performance skills evaluated to the satisfaction of the instructor

CABLEWAYS
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to inspect an aerial system skillfully. The student should also be able to operate a cableway and/or tramway efficiently and safely. This knowledge will be shown by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Distinguish between cableways and tramways.
2. List uses of cableways.
3. Match terms associated with cableways to their correct definitions.
4. Identify basic components of a slackline cableway system.
5. List types of cableways.
6. Select from a list general types of track cables used on cableways.
7. Select from a list points where track cables are exposed to extreme deterioration.
8. Identify fittings often used with wire ropes and strands.
9. Select from a list characteristics of carriages that contribute to the service life of track cables.
10. State safety precautions related to cableways.
11. State suggestions for effective cableway operations.
12. Select from a list items to check when servicing a cableway system (gasoline engine).
13. Demonstrate the ability to
    a. Perform daily inspection on a cableway system.
    b. Perform service on a cableway system.
    c. Perform digging operations using a slackline cableway.

CABLEWAYS
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Provide operator's guides for particular equipment being used.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Stress to students that locations, manipulation of controls, and operating procedures may be different with various models and manufacturers.

   H. Stress to students the importance of safety devices and safety practices when operating equipment.

   I. Obtain and use material for reference, motivation, and complete study of equipment.

   J. Provide other jobs if job sheets are not practical.

   K. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Perform Daily Inspection on a Cableway System

      2. Job Sheet #2--Perform Service on a Cableway System

      3. Job Sheet #3--Perform Digging Operations Using a Slackline Cableway

   E. Test

   F. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. Good, Joel A., assistant manager of Structural Wire Products Sales, United States Steel Corporation, P.O. Box 471, Pittsburg, California 94565.

B. Nichols, Herbert L., Jr. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

C. *Tiger Brand Wire Rope ®, ADUSS55-8081-01.* Pittsburg, California: U.S. Steel Supply, Division of United States Steel, 1982.

CABLEWAYS
UNIT IV

INFORMATION SHEET

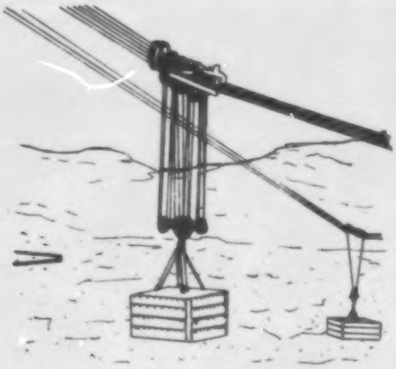
I. Difference between cableways and tramways (Figures 1 and 2)

A. Cableways--Aerial hoisting and conveying systems that operate over clear spans along suspended track cables

(NOTE: Cableways hoist as well as convey, making them very well adapted for handling materials, excavating, placing concrete, and erecting large structures.)

EXAMPLE:

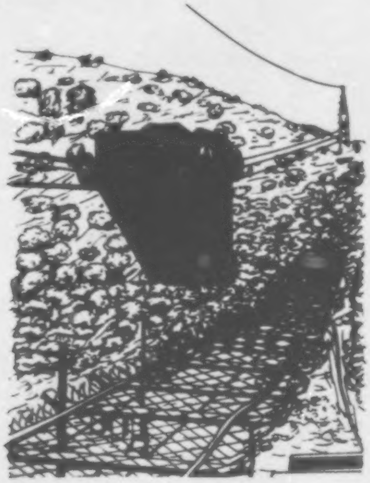
FIGURE 1



B. Tramways--Aerial conveying systems for transporting multiple loads

EXAMPLE:

FIGURE 2



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INFORMATION SHEET

II. Uses of cableways

  A. Conveying materials

  B. Hoisting and lowering materials

  C. Excavating

  D. Placing concrete

  E. Erecting large structures

  F. Conveying passengers (workers)

III. Terms and definitions

  A. Articulated--Jointed

  B. Carrier--Sliding or rolling base or support frame consisting of parallel plates or frames which hold a set of sheave axles

  C. Guy cables--Cables extended from the top of a structure to ground anchors; used to hold and/or steady the structure

  D. Helically--Relating to, or having the shape of, a helix (spiral)

  E. Hoist--Mechanism used for raising and lowering loads

  F. Sheave--Grooved wheel used to support a carrier on a track cable

  G. Slackline cableway--Track or cable that supports an excavator with a bucket; cable is slackened to lower the bucket into the digging and tightened to hoist it

  H. Strand--Symmetrical, helically twisted assembly of wires

  I. Tagline--Line attached to load to help balance and guide load while it is being hoisted

  J. Tower--Structure that is taller than its surroundings

  K. Track cable--Suspended wire rope or strand which the carriers move along on an aerial conveyor

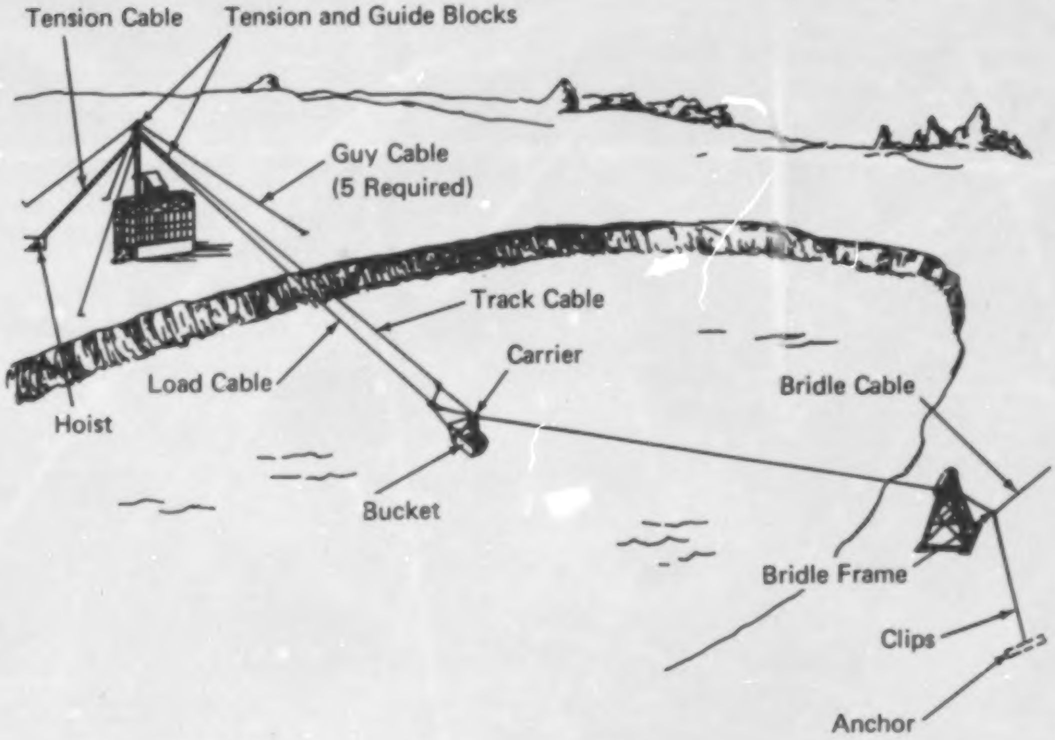
  L. Wire rope--Symmetrical, helically twisted assembly of wire strands

  M. Work cycle--Complete set of operations performed before they are repeated

INFORMATION SHEET

IV. Components of a slackline cableway system (Figure 3)

FIGURE 3


Tension Cable
Tension and Guide Blocks
Guy Cable
(5 Required)
Track Cable
Carrier
Load Cable
Hoist
Bridle Cable
Bucket
Bridle Frame
Clips
Anchor

Used with permission of Sauerman Bros., Inc.

V. Types of cableways

- A. Slackline cableway
- B. Traveling cableway
- C. Stationary cableway with "A" frames
- D. Stationary cableway with towers
- E. Radial cableway

INFORMATION SHEET

F. Aerial passenger cableway or tramway

G. Material-handling tramway

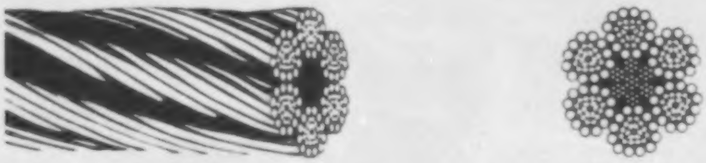
VI. General types of track cables used on cableways (Figures 4-7)

A. Multiple-strand wire rope

(NOTE: This cable is a flattened strand multiple-strand wire rope, but there are other round strand wire ropes that may be used on cableways.)

EXAMPLE:

FIGURE 4



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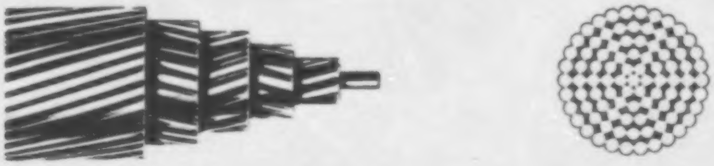
B. Round-wire track strand

EXAMPLE:

FIGURE 5



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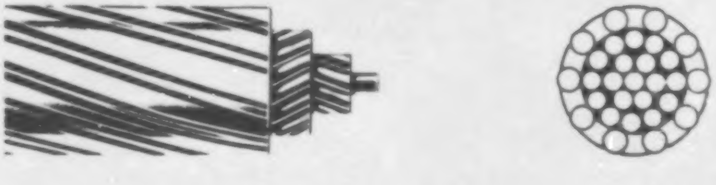
C. Half-lock track strand

EXAMPLE:

FIGURE 6



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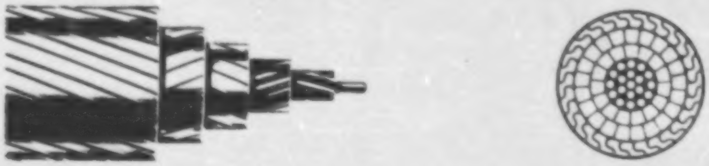
INFORMATION SHEET

D. Locked-coil track strand

(NOTE: Track cables of higher strengths may be manufactured, and many are in successful use; but such cables are generally custom products, designed for specific conditions and uses.)

EXAMPLE:

FIGURE 7



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VII. Points where track cables are exposed to extreme deterioration

(NOTE: These points are referred to as *vibration damping points*.)

A. Terminal sockets

B. Tower saddle contacts

C. Centers of spans

D. Carriage contacts

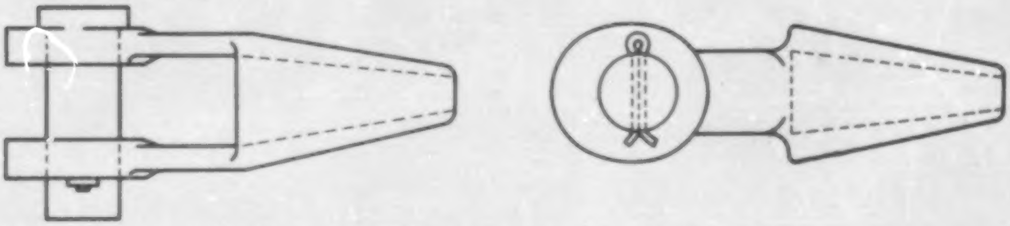
(NOTE: Whenever practical, the track cable should be shifted lengthwise to prevent concentrated stress in portions of the rope.)

VIII. Fittings often used with wire ropes and strands (Figures 8-17)

(NOTE: End fittings on track cables are normally attached with molten zinc; these fittings develop the full strength of the cable.)

A. Open wire rope socket or open strand socket

FIGURE 8



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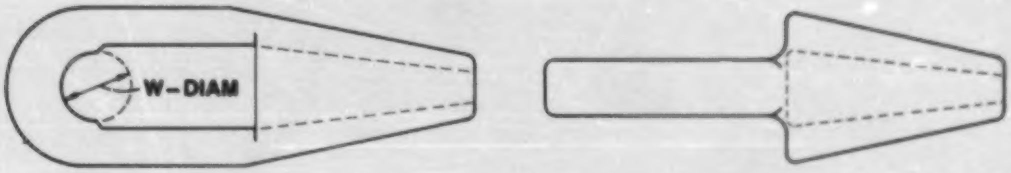
INFORMATION SHEET

B. Closed wire rope socket or closed strand socket

FIGURE 9



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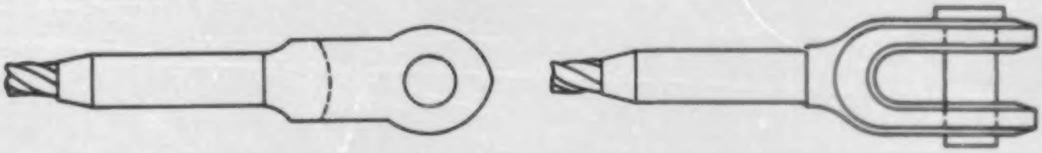
C. Open swaged socket

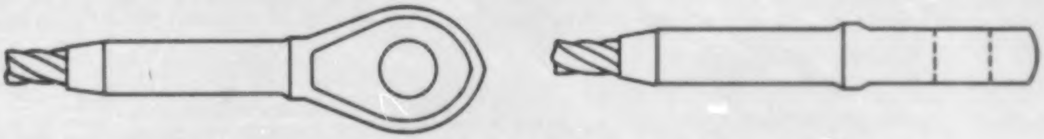
FIGURE 10



Used with permission of USS Tiger Brand Wire Rope, United States Steel.

D. Closed swaged socket

FIGURE 11



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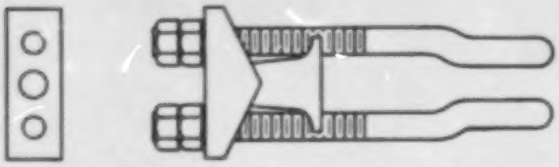
INFORMATION SHEET

E. Open bridge socket or open strand bridge socket

FIGURE 12



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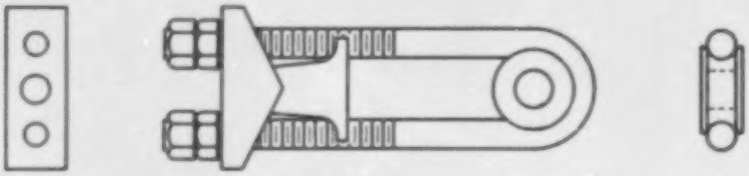
F. Closed bridge socket or closed strand bridge socket

FIGURE 13



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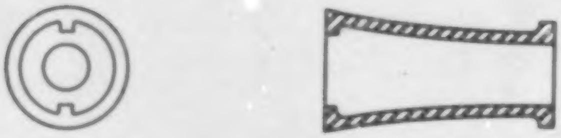
G. Bearing-type strand socket

FIGURE 14



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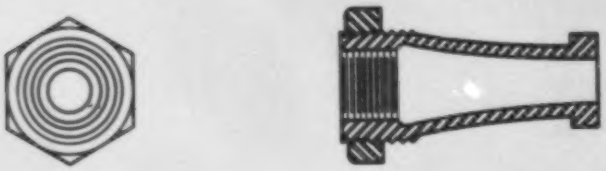
INFORMATION SHEET

H. Tensile-type strand socket

FIGURE 15



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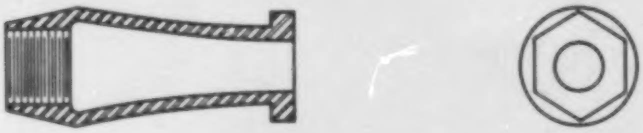
I. Bearing- or tensile-type strand socket

FIGURE 16



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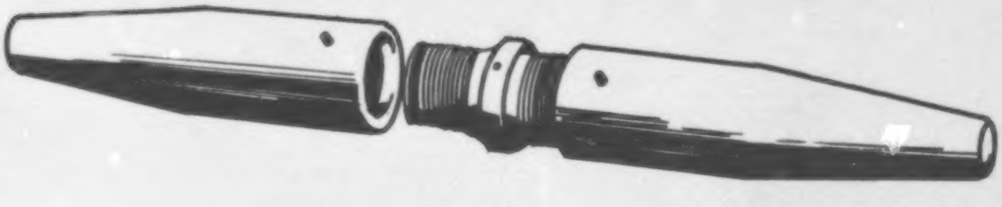
J. Dry-type coupling and terminal

(NOTE: These fittings are used on locked-coil and half-lock track strands and develop very high efficiencies; Figure 17 shows the "thimble-and-wedge" arrangement used in the dry-type fittings.)

FIGURE 17



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INFORMATION SHEET

IX. Characteristics of carriages that contribute to the service life of track cables

   A. Effectiveness of articulation in frame design to distribute the wheel loads
   B. Values of individual wheel loads
   C. Wheel groove contour
   D. Wheel diameter
   E. Wheel spacing
   F. Carriage design

X. Safety precautions related to cableways

   A. Perform daily inspections and regular service
   B. Never overload carrier
   C. Do not operate in extremely high winds
   D. Never operate equipment with broken and/or protruding strands
   E. Inspect towers, guy cables, and anchors frequently
   F. Never let anyone ride on bucket or load
   G. Use extreme caution when lowering buckets near workers
   H. Be sure safety nets are used under material-handling buckets
   I. Check all safety devices for proper operation before using equipment
   J. Know, observe, and follow hand signals given by signal person

XI. Suggestions for effective cableway operations

   A. Do not do anything to cause distraction while operating equipment
   B. Know and respond to signals given by signal person

      (NOTE: Obey stop signals at all times, regardless of who gives them.)

   C. Service equipment regularly
   D. Set up work cycle so that it will be as short as possible
   E. Be sure all loads, buckets, and/or cages are properly secured before starting operations

INFORMATION SHEET

- F. Swing load slowly to avoid throwing load outward or overswinging when carrier stops
- G. Avoid jerky operations; manipulate controls smoothly
- H. Use taglines to help control loads while hoisting
- I. Understand capabilities of equipment before performing operations

XII. Items to check when servicing a cableway system (gasoline engine)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

- A. Visual inspection for leaks and broken, worn, or missing parts
- B. Engine oil level, filter, lines, and hoses
- C. Air cleaner filter (element)
- D. Engine coolant level, radiator cap, hose, and radiator

  (CAUTION: Do not remove radiator cap unless engine is cool; then, open slowly to release pressure.)
- E. Fuel level, fuel filters, and sediment bowl (where applicable)
- F. Battery electrolyte level, battery cables and connections

  (NOTE: Keep sparks and fire away from battery.)
- G. Exhaust system
- H. Hydraulic fluid level, filters, hose, lines, fittings, and possible leaks
- I. Transmission fluid level
- J. Transmission pressure line filter and breather
- K. Brake adjustment and conditions
- L. Brake master cylinder fluid level
- M. Clutch, for proper adjustment
- N. Drive belts, for tension and wear
- O. Wiring, insulation, and connections
- P. Grease fittings
- Q. Carrier and carrier sheaves

INFORMATION SHEET

R. All safety devices

S. Windshield wipers (where applicable)

T. Major components and/or accessories

U. Gauges and controls for proper functioning

V. Towers and/or mast

W. Track cables

(NOTE: All voids inside a track cable are completely filled with lubricant during manufacture, but it is important to relubricate the cable frequently. Drip-type lubricators are either built into the regular carriages, or special lubricator carriages are sent over the lines from time to time. Since this lubricant is usually spread by the carriage wheels, it is necessary to lubricate those portions of the cable not reached by the carriage.)

X. Guy cables, anchors, and clips

Y. Tension cable, tension block, and guide blocks

Z. Buckets and/or cages

AA. Swivel collars

BB. Hoist assembly

CC. Hook and block assembly

DD. Hopper (if applicable)

EE. Tail block assembly

FF. Tower travel assembly (if applicable)

CABLEWAYS
UNIT IV

JOB SHEET #1–PERFORM DAILY INSPECTION ON A CABLEWAY SYSTEM

I. Equipment and materials

   A. Cableway system

   B. Tool kit

   C. Shop rags

   D. Lubricants

   E. Appropriate service manual

II. Procedure

   A. Walk around equipment, visually inspecting for leaks and broken, worn, or missing parts

   (NOTE: Write down on paper any repairs that are needed.)

   B. Check engine oil level

   C. Check radiator coolant level

   D. Check battery electrolyte level and battery cable connections

   E. Check fuel level

   F. Check hydraulic fluid level

   G. Check air cleaner

   H. Check wires, insulation, and connections

   I. Check drive belts for condition and adjustment

   J. Check fuel pump sediment bowl (where applicable)

   K. Check transmission fluid level

   L. Check exhaust system

   M. Check safety devices

   N. Check tracks on carriers on traveling system

   O. Check cleanliness of equipment

   P. Check windshield wipers and windshield (where applicable)

JOB SHEET #1

Q. Check major components and/or accessories

R. Check gauges for normal operation

S. Check controls for proper functioning

T. Visually inspect hoist, hoist assembly, and all hoisting equipment

U. Check all carrier assemblies

V. Check buckets and/or cages

W. Check all cables for broken or worn strands and condition of fittings

X. Check for structural damage on towers and/or mast

Y. Check guy lines, anchors, and connectors

CABLEWAYS
UNIT IV

JOB SHEET #2--PERFORM SERVICE ON A CABLEWAY SYSTEM

I. Equipment and materials

   A. Cableway system

   B. Tool kit

   C. Shop rags

   D. Lubricants

   E. Cleaning solvent

   F. Electrolyte or water

   G. Compressed air supply

   H. Grease gun

   I. Wire brush

   J. New parts, where needed

   K. Appropriate service manual

II. Procedure

   A. Walk around equipment, visually inspecting for leaks and broken, worn, or missing parts

   B. Remove dipstick; wipe clean and replace

   C. Remove dipstick again to check level of engine oil; add oil if necessary

   D. Remove oil filter and check; clean with cleaning solvent, if necessary, and replace

   E. Check lines and hoses for damage or leaks

   F. Check air filter; clean with compressed air or replace

   G. Remove radiator cap to check fluid level; add coolant if necessary

   (CAUTION: Do not remove radiator cap unless engine is cool; then, open slowly to release pressure.)

   H. Check radiator and hoses for leaks; clean debris from outside of radiator

JOB SHEET #2

I. Check fuel level and fill tank if necessary; check filters and replace when necessary; release clamp from sediment bowl and remove, clean, and replace

J. Remove filler caps from battery (where applicable) and check electrolyte level; fill battery, if necessary, with electrolye or water, then replace caps

K. Use a wire brush to clean battery terminals and connectors; if battery is dirty, wash with a baking soda solution, and then apply an anti-corrosion paste to the terminals and connectors

(CAUTION: Keep sparks and fire away from battery.)

L. Check exhaust system for loose connections and holes

M. Check hydraulic fluid level; fill if necessary

N. Remove hydraulic filters; clean if necessary, and replace

O. Check hydraulic system for leaks

P. Remove dipstick from transmission, wipe clean, then replace; remove dipstick to check level of fluid; add fluid if necessary

Q. Check filter and breather; clean or replace as necessary

R. Check brakes and adjustment; readjust or replace if necessary

S. Remove plug from brake master cylinder and check fluid level; add fluid if needed; replace plug

T. Check all clutches for proper adjustment; readjust if necessary

U. Check drive belts for wear and tension; adjust or replace as necessary

V. Visually check all wiring, insulation, and connections; make repairs as necessary

W. Wipe all grease fittings clean; then, using lubricant recommended by manufacturer, lubricate all fittings

X. Check carrier and carrier sheaves for wear

Y. Check all safety devices for condition and proper functioning

Z. Inspect towers, guy cables, and anchors; make adjustments and/or repairs as necessary

AA. Inspect hoist and complete hoisting assembly; lubricate cables and sheaves, and make adjustments and/or repairs as necessary

JOB SHEET #2

BB. Inspect track cables; lubricate, make adjustments, repair, or replace as necessary

CC. Inspect buckets and/or cages; make adjustments or repairs as necessary

DD. Check all gauges for proper operation

EE. Check all controls for proper functioning; lubricate as needed

CABLEWAYS
UNIT IV

JOB SHEET #3--PERFORM DIGGING OPERATIONS USING A SLACKLINE CABLEWAY

I. Equipment--Slackline cableway system

II. Procedure

A. Release drag brake and allow bucket to coast out to digging point

(NOTE: The fastest trip is obtained by holding the track cable at a tension so the bucket will just clear the ground or water as it reaches the digging point. This may require a tight track for distant digging or a slack track for working close to the tower or mast.)

B. Slow bucket movement with drag brake as it reaches digging point

C. Release tension brake to allow track to sag and bucket to lower to ground

(NOTE: If pit is underwater, operator must get used to the feel of the controls and angle at which the track cable enters the water when bucket is making proper contact.)

D. Engage drag clutch (low speed) to pull bucket in

E. Engage tension clutch to tighten track and lift bucket

F. Engage high speed drag (in haul clutch) to pull bucket into the automatic dump

(NOTE: Maximum load of cycle occurs when bucket is being hoisted and pulled in at the same time. For this reason the high speed drag is usually not connected until hoisting is completed.)

CABLEWAYS
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. Distinguish between cableways and tramways. Write a "C" in the blank before the description of cableways and a "T" in the blank before the description of tramways.

_____a. Aerial conveying systems for transporting multiple loads

_____b. Aerial hoisting and conveying systems that operate over clear spans along suspended track cables

2. List four uses of cableways.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

3. Match terms associated with cableways to their correct definitions. Write the correct numbers in the blanks.

_____a. Suspended wire rope or strand which the carriers move along on an aerial conveyor

_____b. Symmetrical, helically twisted assembly of wire strands

_____c. Symmetrical, helically twisted assembly of wires

_____d. Relating to, or having the shape of, a helix (spiral)

_____e. Sliding or rolling base or support frame consisting of parallel plates or frames which hold a set of sheave axles

_____f. Track or cable that supports an excavator with a bucket; cable is slackened to lower the bucket into the digging and tightened to hoist it

_____g. Jointed

_____h. Cables extended from the top of a structure to ground anchors; used to hold and/or steady the structure

1. Strand
2. Slackline cableway
3. Carrier
4. Wire rope
5. Helically
6. Guy cables
7. Track cable
8. Articulated

TEST

_____i. Structure that is taller than its surroundings

_____j. Grooved wheel used to support a carrier on a track cable

_____k. Mechanism used for raising and lowering loads

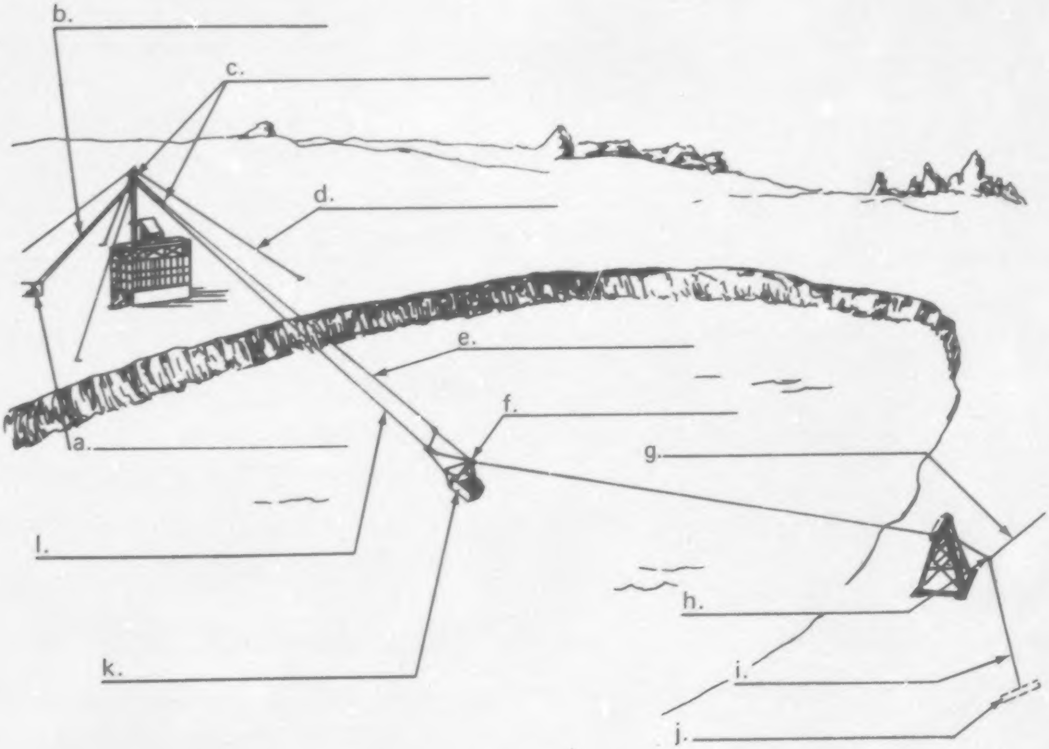
_____l. Complete set of operations performed before they are repeated

_____m. Line attached to load to help balance and guide load while it is being hoisted

9. Tagline
10. Work cycle
11. Tower
12. Hoist
13. Sheave

4. Identify basic components of a slackline cableway system. Write the correct names in the blanks.

Anchor
Carrier
Hoist
Bucket
Bridle cable
Track cable
Load cable
Tension cable
Guy cable (5 required)
Bridle frame
Tension and guide blocks
Clips



TEST

5. List four types of cableways.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

6. Select from the following list general types of track cables used on cableways. Write an "X" in the blank before each correct answer.

_____a. Half-lock guide rope

_____b. High-test choker rope

_____c. Round-wire track strand

_____d. Flattened-strand hoisting rope

_____e. Locked-coil track strand

_____f. Multiple-strand wire rope

_____g. Dragline hoist rope

_____h. Half-lock track strand

7. Select from the following list points where track cables are exposed to extreme deterioration. Write an "X" in the blank before each correct answer.

_____a. Ends of spans

_____b. Centers of spans

_____c. Sheave contacts

_____d. Tower saddle contacts

_____e. Splice connectors

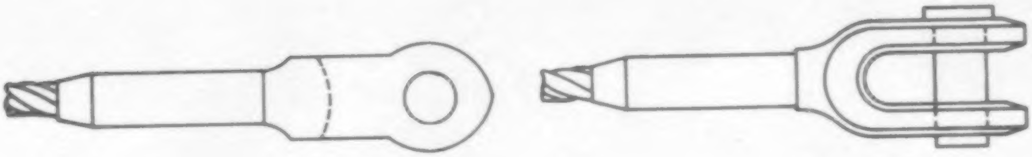
_____f. Terminal sockets

_____g. Carriage contacts

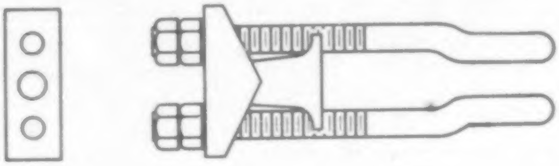
TEST

8. Identify fittings often used with wire ropes and strands. Write the correct names in the blanks. (An illustration may have more than one correct answer.)

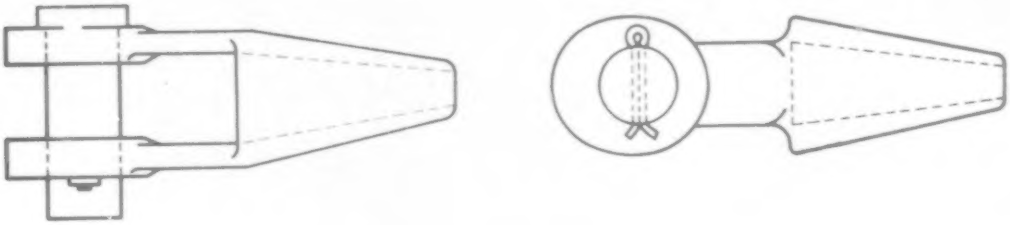
Open wire rope socket
Open strand socket
Open swaged socket
Open bridge socket
Closed bridge socket
Bearing-type strand socket
Tensile-type strand socket
Closed wire rope socket
Closed strand socket
Closed swaged socket
Open strand bridge socket
Closed strand bridge socket
Bearing- or tensile-type strand socket
Dry-type coupling and terminal



a. ______________________________

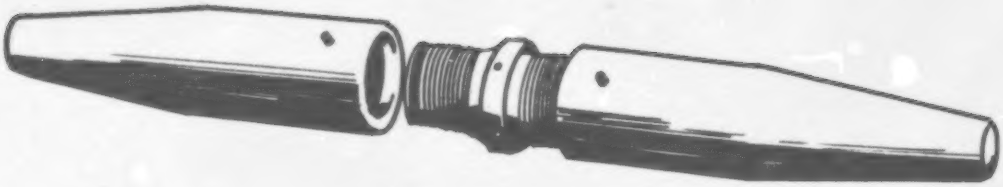


b. ______________________________

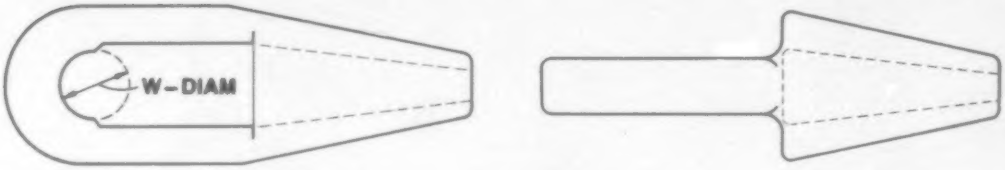


c. ______________________________

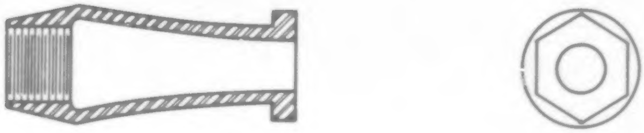
TEST



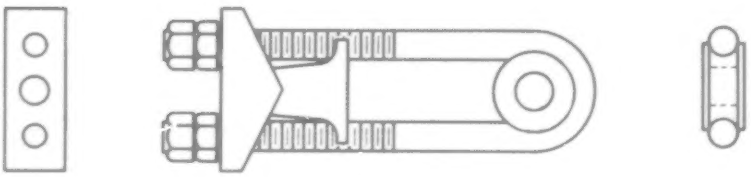
d. ______________________________



e. ______________________________

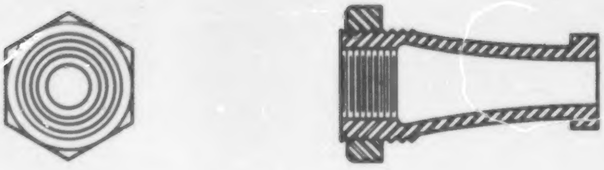


f. ______________________________

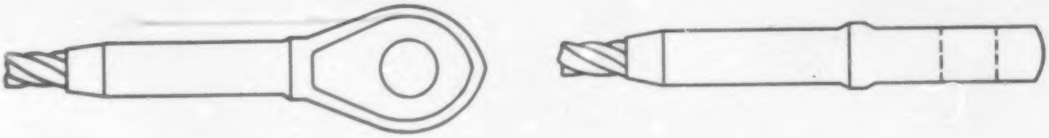


g. ______________________________

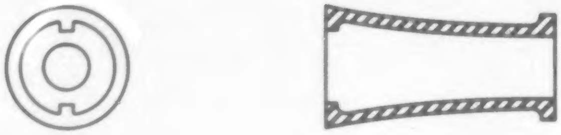
TEST



h. ______________________________



i. ______________________________



j. ______________________________

9. Select from the following list characteristics of carriages that contribute to the service life of track cables. Write an "X" in the blank before each correct answer.

_____a. Number of wheels on carriage

_____b. Weight of the carriage

_____c. Wheel groove contour

_____d. Wheel spacing

TEST

______e. Effectiveness of articulation in frame design to distribute the wheel loads

______f. Size of wheels

______g. Values of individual wheel loads

______h. Carriage design

______i. Wheel diameter

10. State safety precautions related to cableways.

a. ____
____

b. ____
____

c. ____
____

d. ____
____

e. ____
____

f. ____
____

g. ____
____

h. ____
____

i. ____
____

j. ____
____

TEST

11. State five suggestions for effective cableway operations.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

12. Select from the following list items to check when servicing a cableway system (gasoline engine). Write an "X" in the blank before each correct answer.

_____a. Swivel collars

_____b. Type of cable

_____c. Hoist assembly

_____d. Size of sheaves

_____e. Tail block assembly

_____f. Guy cables, anchors, and clips

_____g. Tension cable, tension block, and guide blocks

_____h. Tower travel assembly (if applicable)

_____i. Height of tower

_____j. Brake master cylinder fluid level

_____k. Towers and/or mast

_____l. Grease fittings

_____m. Engine coolant level, radiator cap, hose, and radiator

TEST

______n. Lighting system

______o. Exhaust system

______p. Brake adjustment and conditions

______q. Air cleaner filter (element)

______r. Thermostat

______s. Fuel level, fuel filters, and sediment bowl (where applicable)

______t. Clutch, for proper adjustment

(NOTE: Test question 13 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

13. Demonstrate the ability to

    a. Perform daily inspection on a cableway system.

    b. Perform service on a cableway system.

    c. Perform digging operations using a slackline cableway.

CABLEWAYS
UNIT IV

ANSWERS TO TEST

1. a. T

   b. C

2. Answer should include any four of the following

   a. Conveying materials

   b. Hoisting and lowering materials

   c. Excavating

   d. Placing concrete

   e. Erecting large structures

   f. Conveying passengers (workers)

3. a. 7

   b. 4

   c. 1

   d. 5

   e. 3

   f. 2

   g. 8

   h. 6

   i. 11

   j. 13

   k. 12

   l. 10

   m. 9

4. a. Hoist

   b. Tension cable

   c. Tension and guide blocks

   d. Guy cable (5 required)

   e. Track cable

   f. Carrier

   g. Bridle cable

   h. Bridle frame

   i. Clips

   j. Anchor

   k. Bucket

   l. Load cable

5. Answer should include any four of the following

   a. Slackline cableway

   b. Traveling cableway

ANSWERS TO TEST

- c. Stationary cableway with "A" frames
- d. Stationary cableway with towers
- e. Radial cableway
- f. Aerial passenger cableway or tramway
- g. Material-handling tramway

6. c, e, f, h

7. b, d, f, g

8. a. Open swaged socket
   b. Open bridge socket or open strand bridge socket
   c. Open wire rope socket or open strand socket
   d. Dry-type coupling and terminal
   e. Closed wire rope socket or closed strand socket
   f. Bearing- or tensile-type strand socket
   g. Closed bridge socket or closed strand bridge socket
   h. Tensile-type strand socket
   i. Closed swaged socket
   j. Bearing-type strand socket

9. c, d, e, g, h, i

10. a. Perform daily inspections and regular service
    b. Never overload carrier
    c. Do not operate in extremely high winds
    d. Never operate equipment with broken and/or protruding strands
    e. Inspect towers, guy cables, and anchors frequently
    f. Never let anyone ride on bucket or load

ANSWERS TO TEST

- g. Use extreme caution when lowering buckets near workers
- h. Be sure safety nets are used under material-handling buckets
- i. Check all safety devices for proper operation before using equipment
- j. Know, observe, and follow hand signals given by signal person

11. Answer should include any five of the following
    - a. Do not do anything to cause distraction while operating equipment
    - b. Know and respond to signals given by signal person
    - c. Service equipment regularly
    - d. Set up work cycle so that it will be as short as possible
    - e. Be sure all loads, buckets, and/or cages are properly secured before starting operations
    - f. Swing load slowly to avoid throwing load outward or overswinging when carrier stops
    - g. Avoid jerky operations; manipulate controls smoothly
    - h. Use taglines to help control loads while hoisting
    - i. Understand capabilities of equipment before performing operations
12. a, c, e, f, g, h, j, k, l, m, o, p, q, s, t
13. Performance skills evaluated to the satisfaction of the instructor

PILE DRIVERS
(PILE HAMMERS)
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to set up equipment and drive different types of piles. This knowledge will be shown by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of pile drivers.
2. Match terms associated with pile drivers to their correct definitions.
3. Name basic types of pile drivers.
4. Identify types of pile hammers.
5. Identify basic parts of a diesel pile hammer.
6. Identify types of driving heads used on piles.
7. List types of piles.
8. Select from a list auxiliary equipment used on or with pile drivers.
9. State conditions that contribute to pile extraction hazards.
10. Identify methods and/or equipment used for pile extraction.
11. Identify types of cofferdams.
12. State safety rules related to pile driving.
13. State suggestions for effective pile driving operations.
14. Label hand signals commonly used with pile drivers.
15. Demonstrate the ability to
    a. Perform daily inspection on a diesel pile driver.
    b. Drive wooden piles.
    c. Drive steel H piles.
    d. Drive composite piles (wood and concrete).
    e. Drive steel sheet piles.

PILE DRIVERS
(PILE HAMMERS)
UNIT V

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Make transparencies.

   B. Provide students with objective sheet.

   C. Provide students with information and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Emphasize to students the importance of safety rules and precautions.

   G. Demonstrate and discuss procedures outlined in job sheets.

   H. Provide other jobs if job sheets are not practical.

   I. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM #1--Types of Sheet Piling

      2. TM #2--Types of Cofferdams

   E. Job sheets

      1. Job Sheet #1--Perform Daily Inspection on a Diesel Pile Driver

      2. Job Sheet #2--Drive Wooden Piles

      3. Job Sheet #3--Drive Steel H Piles

      4. Job Sheet #4--Drive Composite Piles (Wood and Concrete)

      5. Job Sheet #5--Drive Steel Sheet Piles

   F. Test

   G. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. Cleveland, Floyd M., and Irving Cleveland. *Pile Driving Guide.* Plantation, Florida: F. & I. Cleveland, 1963.

B. *Condensed Catalog.* Dover, Delaware: MKT Geotechnical Systems, n.d.

C. *Department of the Army Technical Manual TM5-3895-265-14.* Washington, D.C.: Headquarters, Department of the Army, 1969.

D. *Safety in Industry Instructor's Outline, Bulletin 305.* Washington, D.C.: U.S. Department of Labor Safety Training Programs, U.S. Government Printing Office, 1967.

PILE DRIVERS
(PILE HAMMERS)
UNIT V

INFORMATION SHEET

I. Uses of pile drivers (Figure 1)

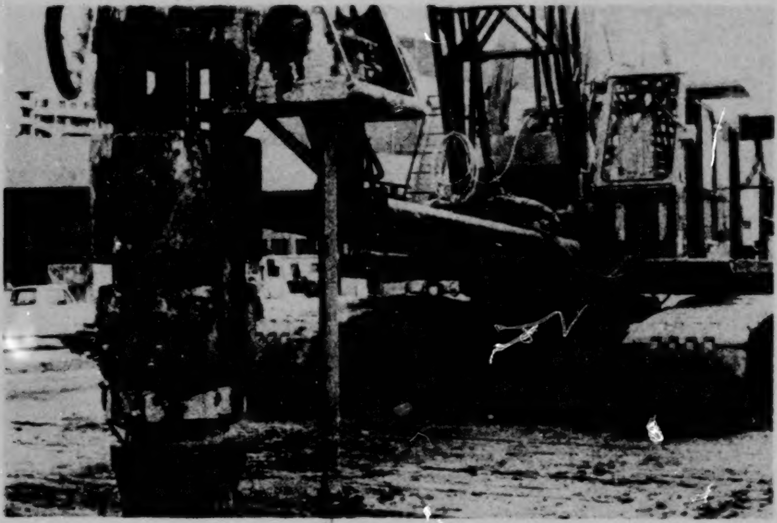
A. Drive piling to form continuous walls that will resist pressure from earth or water

B. Drive piling for cutoff walls under structures to retard water flow

C. Drive piling for load bearing

D. Drive piling for retaining walls

FIGURE 1



II. Terms and definitions

A. Piling--Support beams, slabs, or columns of wood, steel or concrete placed in the soil for the purpose of transmitting a load through water, or strata of poor bearing capacity, to a stratum of adequate bearing capacity

(NOTE: Piling may transmit a load downward or laterally and, in some cases, may anchor an upward pull.)

INFORMATION SHEET

B. Pile driver--A machine with hoisting apparatus, leads, and frame, for handling and driving piles

C. Strata--A sheetlike mass of sedimentary rock or earth of one kind lying between beds of other kinds

D. Composite pile--Pile made up of different materials, usually concrete and wood or steel fastened together end to end, to form a single pile

E. Leads--Vertical hanging frame that guides the hammer and pile

(NOTE: Quite often, double-acting hammers are operated with skirts or pants [fishtail extensions] free hanging to drive piles.)

F. Drive cap--Steel cap placed over driving end of a pile to prevent damage during driving and to distribute impact of hammer evenly over the head of the pile

G. Stress--Intensity of the force, developed per unit area within a body, in resisting the forces acting on it

H. Follower--A member placed between the pile and hammer when head of pile is to be driven deeper than hammer can reach

I. Cribbing--Lining of a shaft

J. Cant hook--Stout, wooden lever with adjustable steel hook near the lever end; usually used for handling logs

K. Brooming--Crushing and spreading of the top of a wooden pile without a driving band when it is driven into hard ground

L. Chamfering--Beveling the edges of the heads of wooden piles

M. Waler--Horizontal brace used to hold timbers in place against sides of an excavation or pile wall

N. Deadman--An anchor for a guy line

O. Guy line--Line used between deadmen and sheeting to support the structure; also, a line used to hold and/or steady a high structure

P. Cross bracing-- A system of members which connect frames or panels laterally to make a continuous structure

Q. Grouting--Process of injecting grout (sand, cement, and water mixture) into forms and or interlocking joints for the purpose of stabilization and water tightness

R. Cofferdam--Somewhat watertight enclosure within which excavation can proceed to a firm foundation

S. Tagline--Safety line used to hold and/or steady a load while being hoisted

INFORMATION SHEET

T. Foot block--Block at the base of a strut or brace

U. Refusal--Point when piling will not go any deeper; may indicate specified minimum penetration per blow

V. Moon beam--Curved or horizontal beam attached to the pile driver in a way that permits swinging and holding the leads for driving batter piles at an angle to the machine

W. Batter piles--Leaning piles; used to carry substantial lateral loads

X. Fender piles--Used to prevent wear and absorb shock on places such as bridge piers and docks

Y. Bearing piles--Supporting piles for stuctures; bearings are reached by point bearing, friction, or friction and compaction

Z. Anchor piles-Used to fasten tieback rods to hold seawalls in true lines against ground pressure; also used for anchoring high towers

AA. False pile–Temporary pile used to support falsework in construction of bridges or to support steel beams on bridge structures until they are connected

BB. Dolphine pile--Cluster of pile driven on a batter and bound together at the top

CC. Fixed leads--Leads underslung from a crane boom or extended beyond head of boom, holding the pile in true alignment while driving; standard fixed leads are slung from boom point with braces running from bottom of leads to crane frame

DD. Swinging leads (flying leads)--Leads suspended at the top to permit vertical or lateral movement or swinging through an arc; permits coverage of a wider area in one setup

EE. Lagging--Placing of timbers between H piles to increase frictional area in the soil

FF. Mandrel--Long, tubular-type tool made to fit inside a casing to drive piling and/or drive casings; some are made with points on one end and are driven into the ground to form pilot holes for piling

GG. Single-acting hammer–Type of ram that uses pressure on underside to raise it, and is then allowed to fall by means of gravity

HH. Double-acting hammer--Type of ram with a closed top cylinder, into which the rising ram compresses air, imparting extra drive to the downstroke of the ram

INFORMATION SHEET

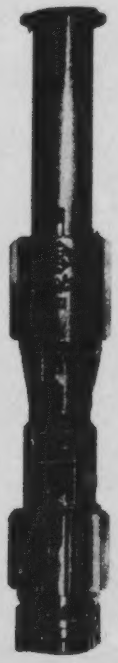
III. Basic types of pile drivers

- A. Drop
- B. Steam or air
- C. Diesel
- D. Hydraulic
- E. Sonic or vibratory

IV. Types of pile hammers (Figures 2-7)

A. Diesel single-acting

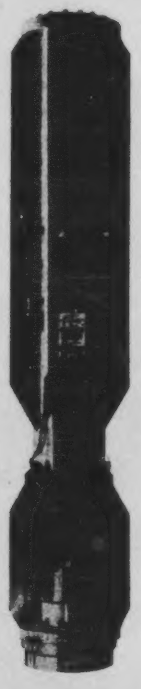
FIGURE 2



Courtesy of MKT Geotechnical Systems.

B. Diesel double-acting

FIGURE 3

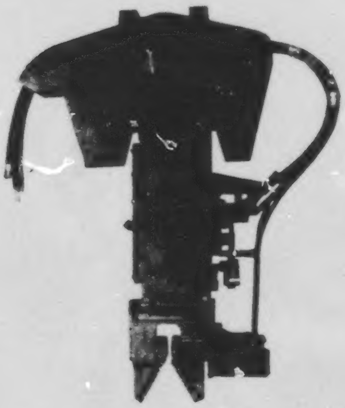


Courtesy of MKT Geotechnical Systems.

INFORMATION SHEET

C. Hydraulic vibratory driver/ extractor

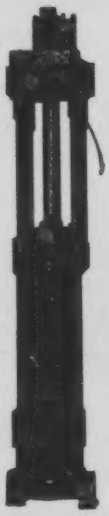
FIGURE 4



Courtesy of MKT Geotechnical Systems.

D. Variable stroke steam/air single-acting

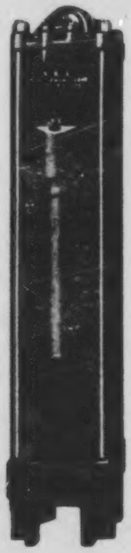
FIGURE 5



Courtesy of MKT Geotechnical Systems.

E. Steam/air double-acting

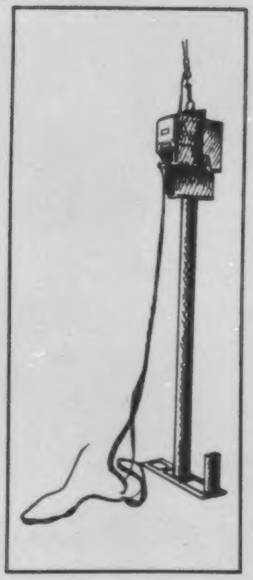
FIGURE 6



Courtesy of MKT Geotechnical Systems.

F. Sonic

FIGURE 7

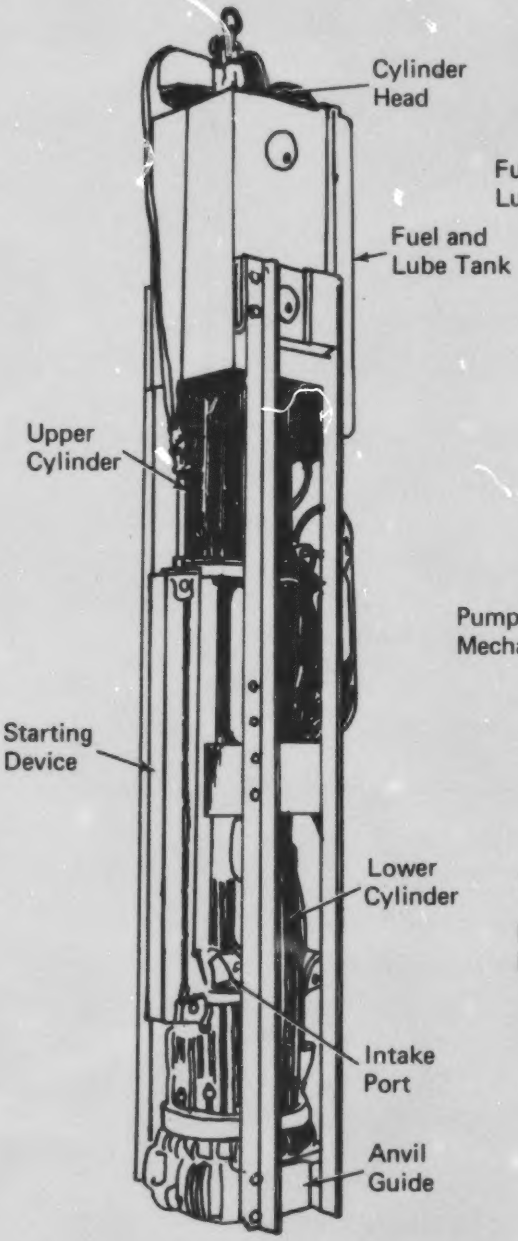


INFORMATION SHEET

V. Basic parts of a diesel pile hammer (Figures 8 and 9)

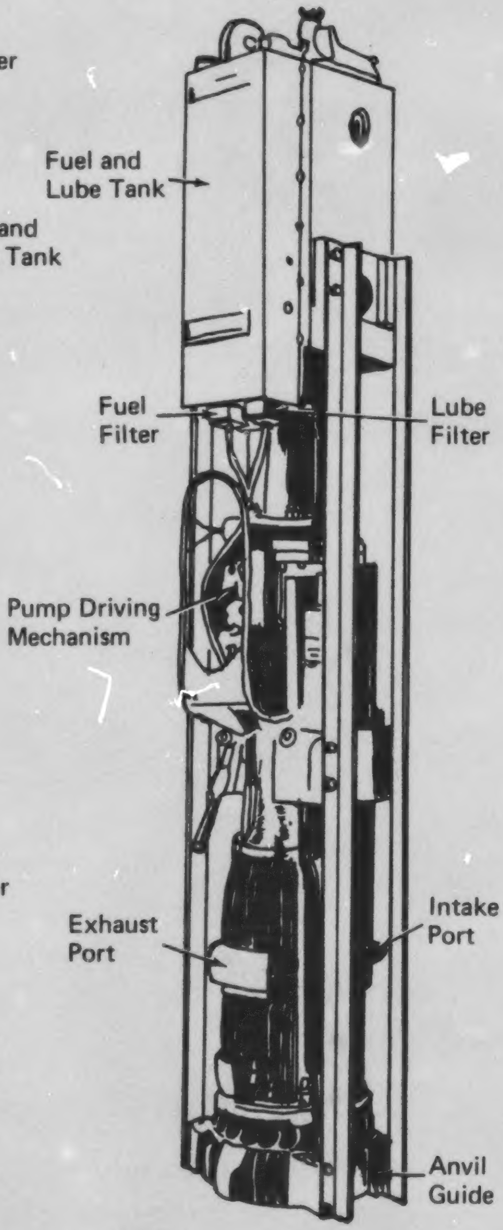
A. Right rear, three-quarter view

FIGURE 8


Cylinder Head
Fuel and Lube Tank
Upper Cylinder
Starting Device
Lower Cylinder
Intake Port
Anvil Guide

B. Left front, three-quarter view

FIGURE 9


Fuel and Lube Tank
Fuel Filter
Lube Filter
Pump Driving Mechanism
Exhaust Port
Intake Port
Anvil Guide

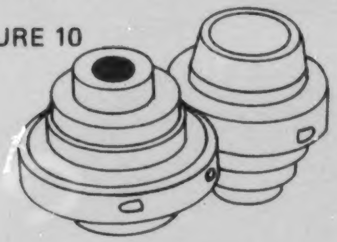
INFORMATION SHEET

VI. Types of driving heads used on piles (Figures 10-16)

(NOTE: Cushion blocks [wood or fiber] should be used with driving heads.)

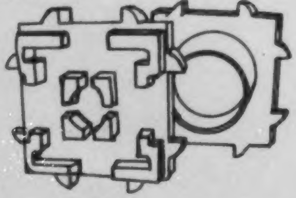
A. Pipe

FIGURE 10



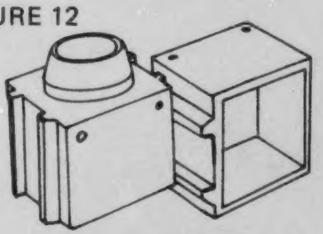
B. H beam

FIGURE 11



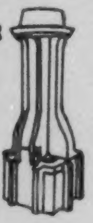
C. Concrete

FIGURE 12



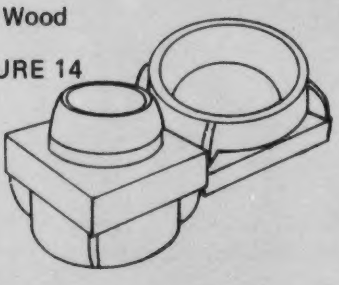
D. Pedestal (for concrete piles with extending reinforced rods)

FIGURE 13



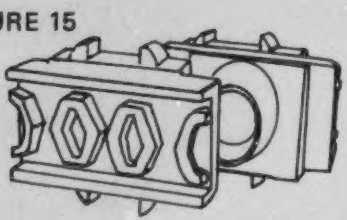
E. Wood

FIGURE 14



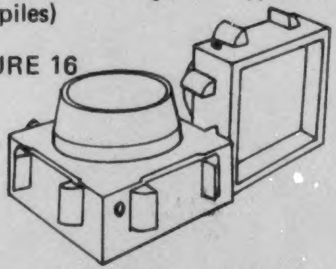
F. Steel sheet

FIGURE 15



G. Round and square flat face (for limited driving of all types of piles)

FIGURE 16



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INFORMATION SHEET

VII. Types of piles (Transparency #1)

A. Timber

B. Cast-in-place concrete

C. Precast concrete

D. Steel H pile

E. Steel pipe

F. Composite

G. Wood sheet

(NOTE: Wood piling is made in different types, such as wakefield, tongue and groove, and planking.)

H. Concrete sheet

I. Steel sheet

(NOTE: Steel sheet piling is made in many shapes, such as flat, Z, and U.)

J. Tapered steel shell (monotube)

VIII. Auxiliary equipment used on or with pile drivers

(NOTE: Various protective devices are used to prevent excessive stress on piles during the driving process; preventing stress helps to reduce the accident potential.)

A. Metal hood, steel band, or cable used on wooden piles

(NOTE: These devices are used on wooden piles to protect them from "brooming" or splitting; also, chamfering the edges of the pile head will help.)

B. Woven rope or wood block cushions

C. Followers

D. Cribbing

E. Chains and cables

F. Skids and ropes (used for unloading)

G. Cant hooks

INFORMATION SHEET

  H. Scaffolds
  I. Jacks
  J. Shores
  K. Come-alongs (portable winches)
  L. Ladders
  M. Anvils
  N. Drive caps

IX. Conditions that contribute to pile extraction hazards

  A. Deep penetration when originally installed
  B. Exposure to severe bending movement
  C. Damage which occurred during original driving
  D. Sand, rust, dirt, or other material lodged in the interlocks
  E. Locking action caused by grouting
  F. Piling which has been placed for a long time
  G. Loss of the screwbolt through vibration in extractor connections
  H. Cable and hook failure
  I. Ground friction

INFORMATION SHEET

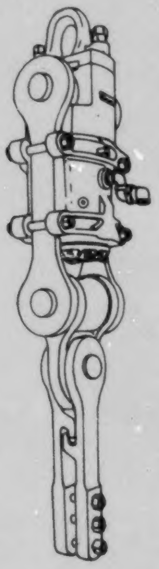
X. Methods and/or equipment used for pile extraction (Figures 17-24)

(NOTE: Usually, a crane is used to actually raise the piles, but this could be done with any other type of hoisting equipment.)

A. Extracting hammer

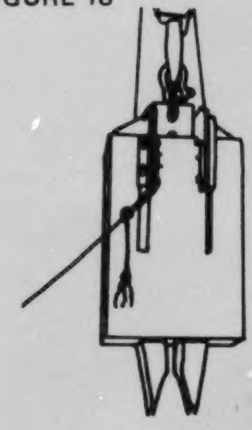
(NOTE: This applies quick, sharp blows to the pile while being extracted with a derrick or crane.)

FIGURE 17



B. Wood pile extractor

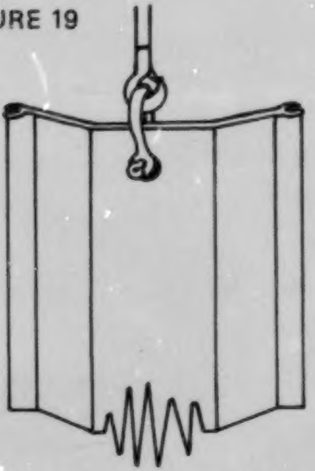
FIGURE 18



INFORMATION SHEET

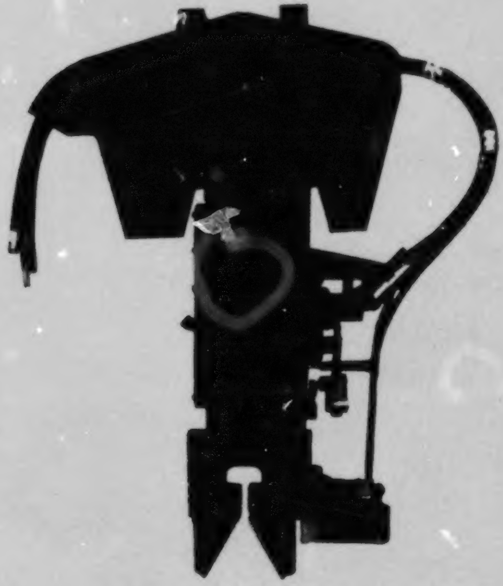
C. Hooks fastened through holes, rings, or shackles in top of pile

FIGURE 19



D. Vibratory type with clamp

FIGURE 20

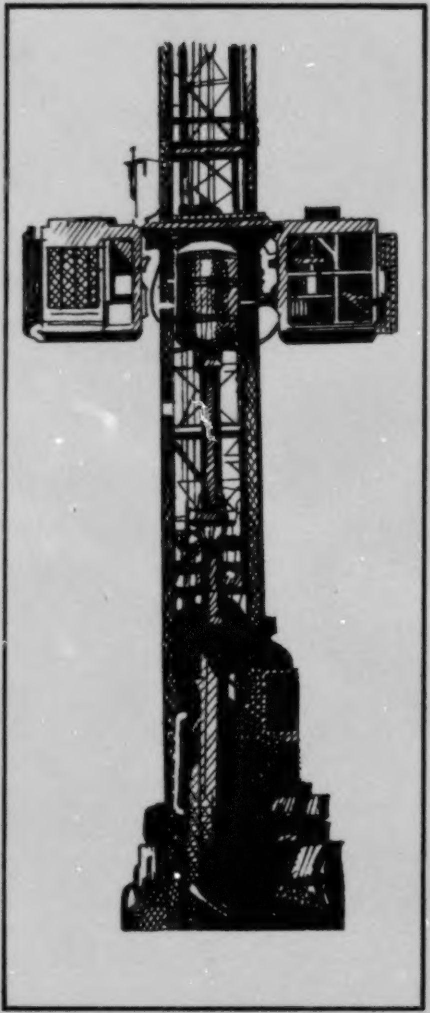


Courtesy of MKT Geotechnical Systems.

INFORMATION SHEET

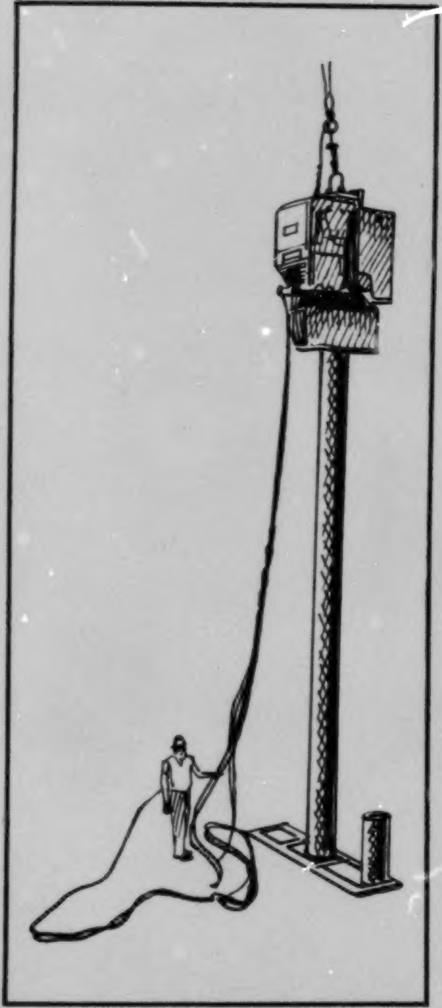
E. Vibratory

FIGURE 21



F. Sonic

FIGURE 22

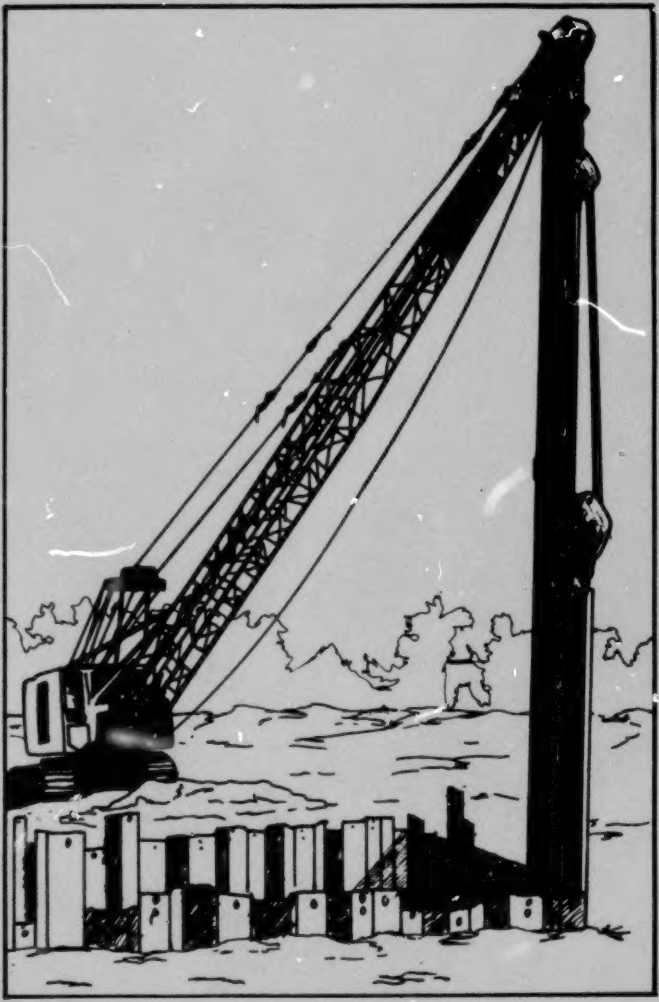


(NOTE: It may be necessary to use more than one method to extract some piles.)

INFORMATION SHEET

G. Crane with pulling stick

FIGURE 23

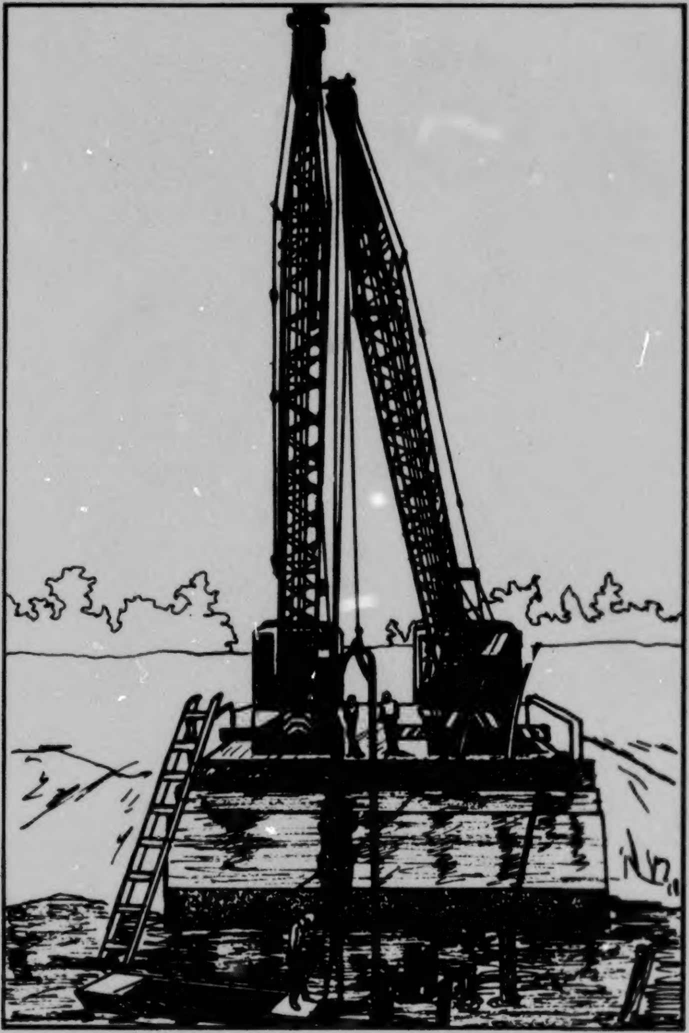


(NOTE: When using a pulling stick of heavy timber or steel, one end is fastened under the boom point and the other end sits on the sheet next to one to be pulled. A multiple sheave block is fastened to the boom end of the stick and another block is fastened to the sheet which is being pulled. With this method you get a pull of a five to eight part line without any strain on crane.)

INFORMATION SHEET

H. Pulling pile, using extractor and jetting

FIGURE 24



XI. Types of cofferdams (Transparency #2)

- A. Slanted arc wall
- B. Circular with rib bracing
- C. Diaphragm type with cross bracing
- D. Cellular rib braced and interconnected

INFORMATION SHEET

XII. Safety rules related to pile driving

- A. Inspect guy lines and leads frequently
- B. Inspect ladders, platforms, and scaffolding regularly
- C. Secure ends of steam and/or air hoses to prevent them from whipping
- D. Block hammers at base of leads to prevent them from falling when not in use
- E. Inspect all ropes, slings, chains, and blocks frequently
- F. Know and follow hand signals
- G. Wear protective clothing where and when required
- H. Use taglines when positioning pile in leads; keep hands and arms away from pile and guide, and off top of pile
- I. Keep working platforms clean
- J. Keep all incidental and auxiliary equipment in safe operating condition
- K. Keep pile leads securely bolted
- L. Inspect entire rig daily for loose parts
- M. Provide lifelines for personnel where necessary
- N. Wear life jackets when working on waterborne structures
- O. Provide lifelines and life rings on boats, trestles, barges, and other water equipment
- P. Keep boats handy for emergency use

XIII. Suggestions for effective pile driving operations

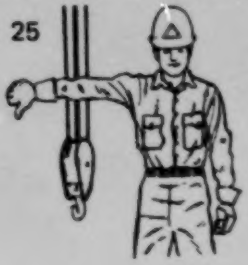
- A. Start piles correctly
- B. Do not try to bend piles
- C. Keep hammer and leads free of burrs or other projections
- D. Keep all equipment in good and safe operating condition
- E. Use protective devices on piles during driving process
- F. Perform maintenance regularly

INFORMATION SHEET

XIV. Hand signals commonly used with pile drivers (Figures 25-41)

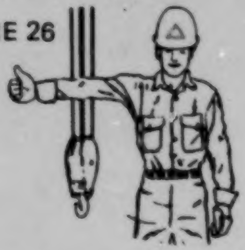
A. **Lower boom**--Arm extended, fingers closed, thumb pointing downward

FIGURE 25



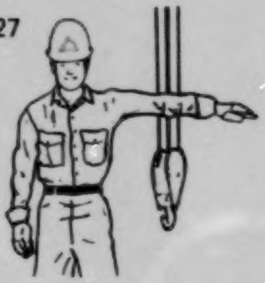
B. **Raise boom**--Arm extended, thumb pointing up, flex fingers in and out as long as movement is desired

FIGURE 26



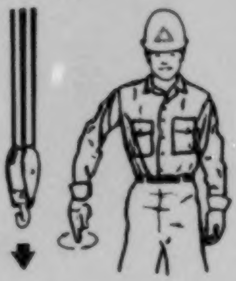
C. **Stop**--Arm extended, palm down, hold poistion rigidly

FIGURE 27



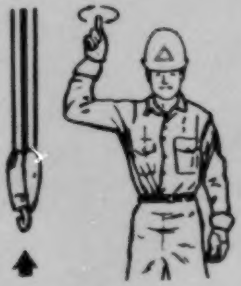
D. **Lower load**--Arm extended downward, forefinger pointing down, move hand in small horizontal circle

FIGURE 28



E. **Hoist load**--Forearm vertical, forefinger pointing up, move hand in small, horizontal circle

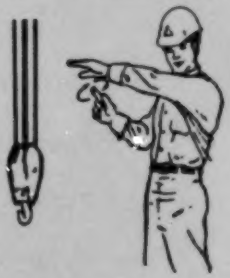
FIGURE 29



F. **Move slowly**--Place one hand motionless in front of hand giving motion signal

EXAMPLE: Hoist slowly

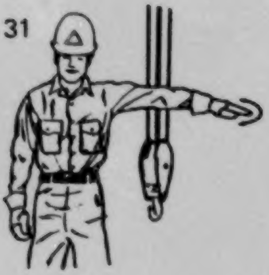
FIGURE 30



INFORMATION SHEET

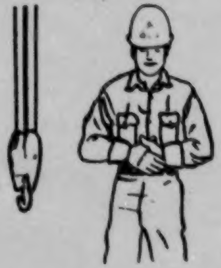
G. **Emergency stop**--Arm extended, palm down, move hand rapidly right and left

FIGURE 31



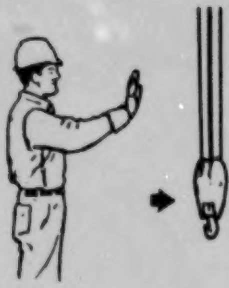
H. **Dog everything**--Clasp hands in in front of body

FIGURE 32



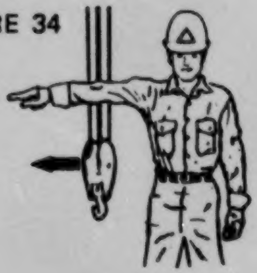
I. **Travel crane**--Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel

FIGURE 33



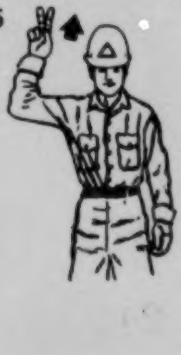
J. **Swing**--Arm extended, point with finger in direction of swing of boom

FIGURE 34



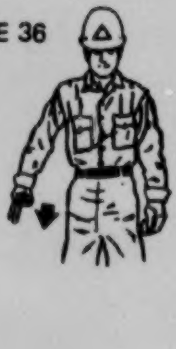
K. **No. 2 line up**--Forearm vertical, two fingers pointing up

FIGURE 35



L. **No. 2 line down**--Forearm down, two fingers pointing down

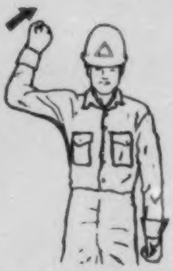
FIGURE 36



INFORMATION SHEET

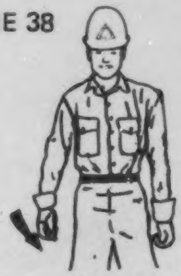
M. **Raise hammer**--Forearm vertical, fist up

FIGURE 37



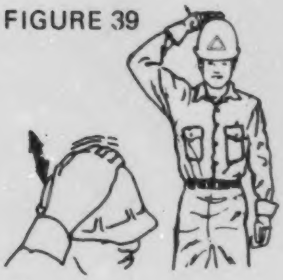
N. **Lower hammer**--Arm extended downward, fist down

FIGURE 38



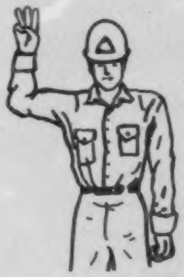
O. **Fire hammer**--Tap top of hat with palm of hand

FIGURE 39



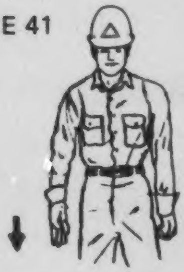
P. **No. 3 line up**--Forearm vertical, three fingers pointing up

FIGURE 40



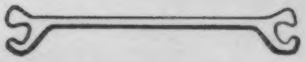
Q. **No. 3 line down**--Arm extended downward, three fingers pointing down

FIGURE 41

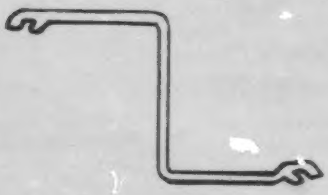


Types of Sheet Piling

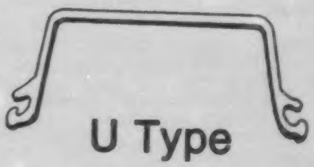
Steel



Flat Type

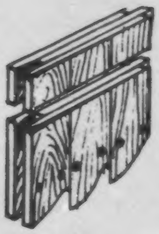


Z Type

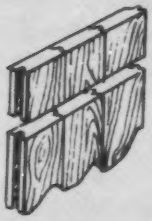


U Type

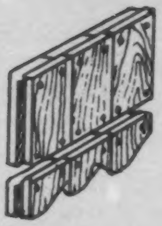
Wood



Wakefield

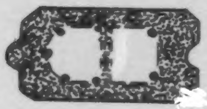


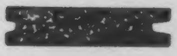
Tongue and Groove



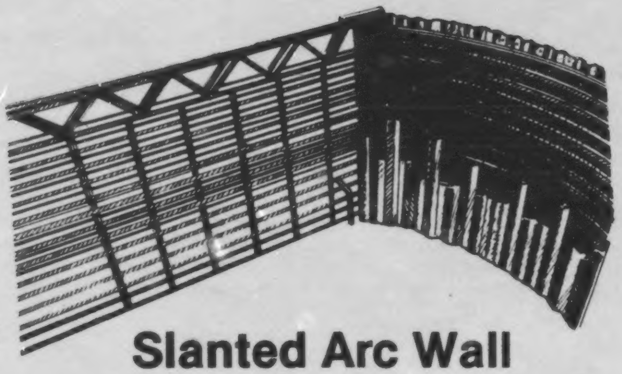
Planking

Concrete

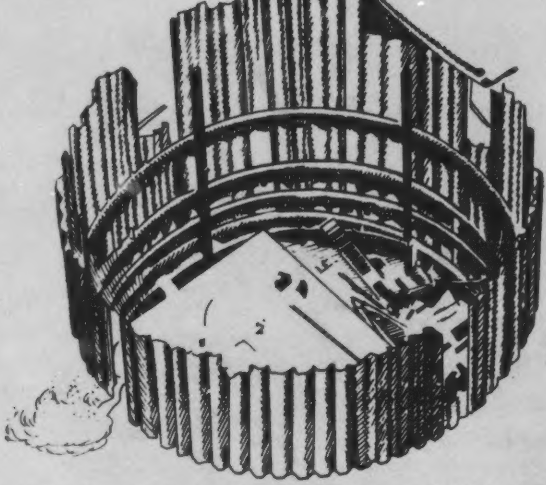




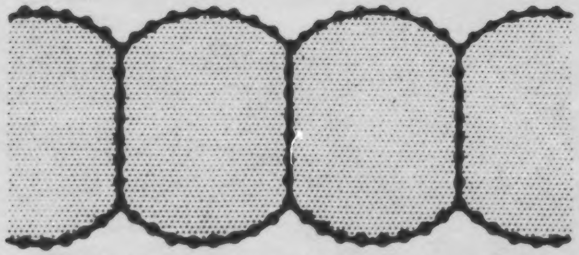
Types of Cofferdams



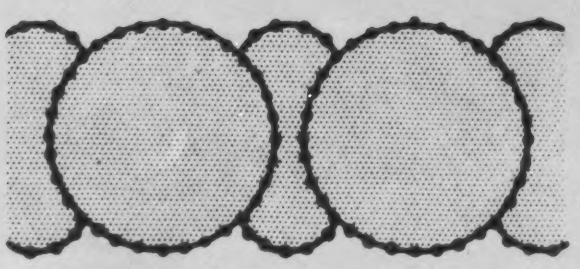
Slanted Arc Wall



Circular with Rib Bracing



Diaphragm Type with Cross Bracing



Cellular Rib Braced and Interconnected

TM #2

HEO II - 219-A

2

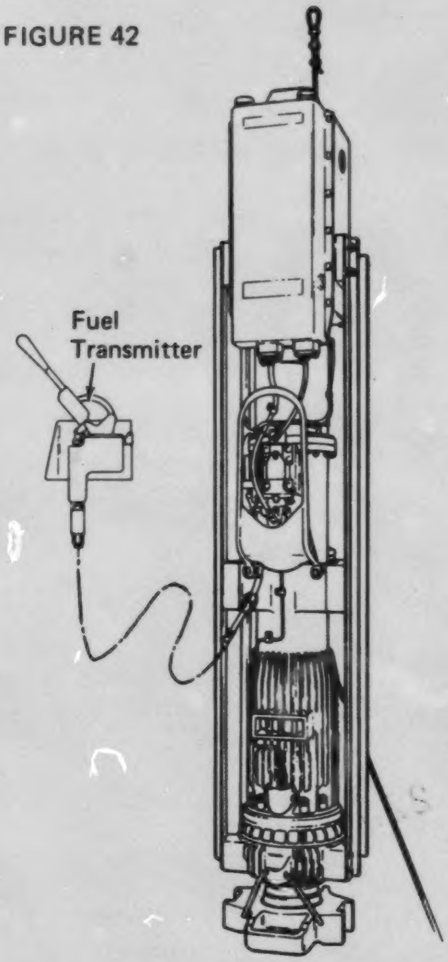
PILE DRIVERS
(PILE HAMMERS)
UNIT V

JOB SHEET #1--PERFORM DAILY INSPECTION ON A DIESEL PILE DRIVER

I. Equipment and materials

- A. Pile driver and accessories (Figure 42)
- B. Note pad and/or checklist
- C. Service manual
- D. Tool kit
- E. Rags

FIGURE 42



JOB SHEET #1

II. Procedure

A. Visually inspect; walk around equipment, checking for any broken, worn or missing parts, and leaks; make a note of any repairs that are necessary

B. Check hydraulic reservoir level; add fluid if necessary

C. Check major components

D. Check fuel mechanical lubrication system and injectors; add as necessary

E. Check vertical cylinder, piston, and anvil

F. Check all ropes, cables, and drums

G. Check starting device

H. Bleed the hydraulic control system

I. Make sure all hydraulic hoses are full of oil and connected at hammer

J. Start diesel hammer

K. Operate hammer, observing for any unusual noise or vibration

L. Make any necessary adjustments

PILE DRIVERS
(PILE HAMMERS)
UNIT V

JOB SHEET #2--DRIVE WOODEN PILES

I. Equipment and materials

A. Crane with leads

B. Hammer (single-acting air)

C. Air compressor with hose

D. Wood piles (50' treated)

E. Rope and chain

II. Procedure

(CAUTION: Keep very close watch during driving procedures to avoid damage to pile and/or hammer.)

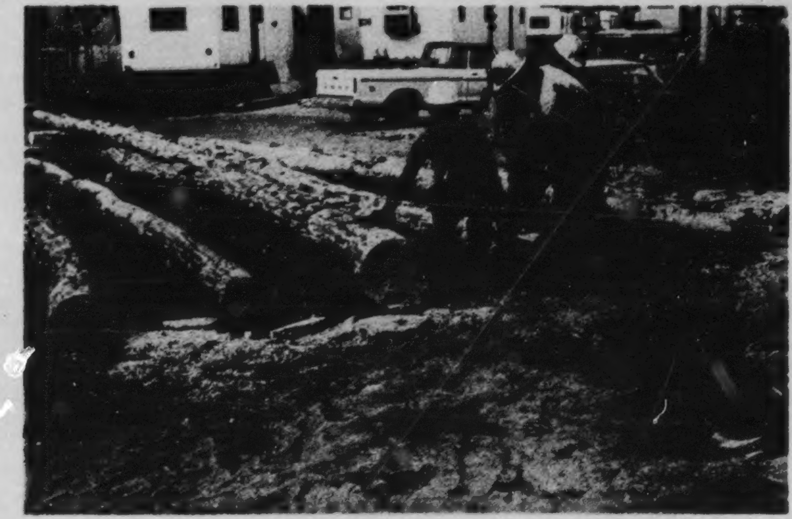
A. Position crane for driving operations

B. Raise hammer up in leads to about two-thirds of the height of the pile

C. Swing boom to center hoist line over top end of pile

D. Lower hoist line and attach around top of pile about 1 1/2'-2' from end (Figure 43)

FIGURE 43

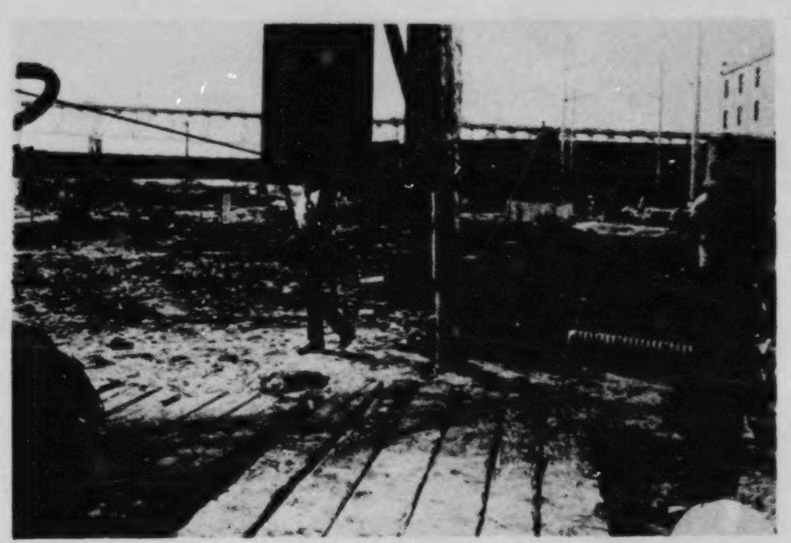


JOB SHEET #2

E. Raise pile up into leads and center under the cap in a plumb position (Figure 44)

(NOTE: Ground crew will assist in aligning pile into leads and in position.)

FIGURE 44



F. Position bottom of pile on top of stake or in pilot hole (Figure 45)

FIGURE 45

JOB SHEET #2

G. Begin driving operation

H. Maneuver crane and/or boom to keep pile and leads plumb

I. Continue driving until top of pile is about ten feet from top of ground then stop long enough to release hoist line from pile

J. Continue driving until pile is at proper depth (Figure 46)

FIGURE 46

K. Raise pile hammer in leads to clear driven pile

L. Position crane for driving next pile and raise hammer in leads to about two-thirds of the height of the pile

M. Swing boom to center hoist line over top end of pile

N. Lower hoist line and attach to pile about 1 1/2'-2' from end

O. Raise pile up into leads and center under the cap in a plumb position

P. Position bottom of pile on top of second stake or in second pilot hole and begin driving operations

Q. Repeat driving operations until all of the piles are driven

PILE DRIVERS
(PILE HAMMERS)
UNIT V

JOB SHEET #3–DRIVE STEEL H PILES

I. Equipment and materials

   A. Crane with leads

   B. Hammer

   C. Piles (steel H)

   D. Cable choker

II. Procedure

   A. Position crane for driving operations

      (NOTE: Set hammer so that it is level with bottom of leads when setting H piles, pipe piles, and concrete piles.)

   B. Swing boom to center hoist line over top end of pile

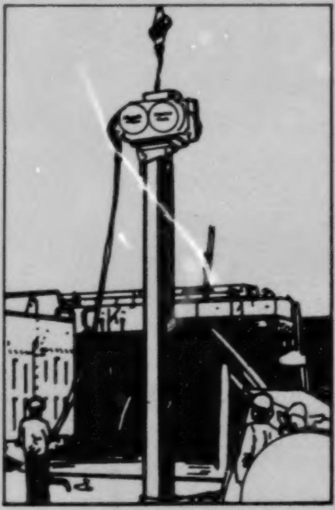
   C. Lower hoist line and attach pile

   D. Raise pile to a vertical position

   E. Raise hammer up into leads slightly above top of pile

   F. Maneuver pile into leads and center under the cap in a plumb position (Figure 47)

FIGURE 47



Courtesy Pileco, Inc.

JOB SHEET #3

G. Position bottom of pile on top of stake (location for pile to be set)

H. Lower hammer until cap rests on top of pile and begin driving operations

I. Maneuver crane and/or boom to keep pile and leads in a plumb position

J. Continue driving until top of pile is about ten feet from top of ground; then, remove hoist line from pile

K. Continue driving until pile is at proper depth

L. Raise hammer off pile

M. Position crane for driving next pile

N. Lower hammer to bottom of leads

O. Swing boom to center hoist line over top end of pile

P. Lower hoist line and attach through hole in top of pile

Q. Raise pile up in a plumb position

R. Raise hammer up into leads slightly above top of pile

S. Maneuver pile into leads and center under cap in a plumb position

T. Position bottom of pile on top of stake

U. Lower hammer until cap rests on pile and begin driving

V. Repeat driving operations until all of the piles are driven

PILE DRIVERS
(PILE HAMMERS)
UNIT V

JOB SHEET #4--DRIVE COMPOSITE PILES (WOOD AND CONCRETE)

I. Equipment and materials

   A. Crane with leads

   B. Hammer (single-acting air)

   C. Air compressor with hose

   D. Rigid punch

      (NOTE: Choose punch as required to clear surface obstructions.)

   E. Driving mandrel

      (NOTE: Mandrel must be of sufficient length for metal can to be used.)

   F. Six wood piles (50'--untreated)

      (NOTE: Quality and length of piles is determined by project specifications.)

   G. Six metal cans (corrugated metal casing or shell)

   H. Mats

   I. Chain

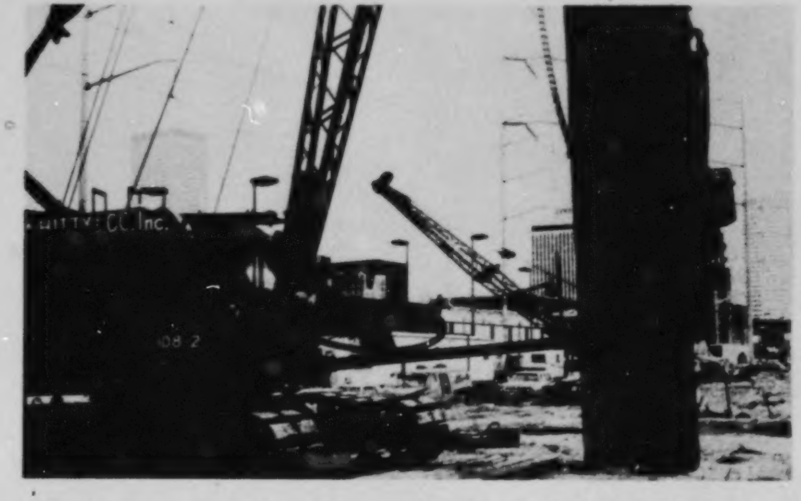
JOB SHEET #4

II. Procedure

A. Locate mats as necessary for equipment to rest on while performing pile driving operations (Figure 48)

(NOTE: Make sure mats are on solid, level ground.)

FIGURE 48



B. Move crane onto mats and in position for driving operations

C. Swing boom to center hoist line over punch; lower hoist line and attach to punch (Figure 49)

FIGURE 49

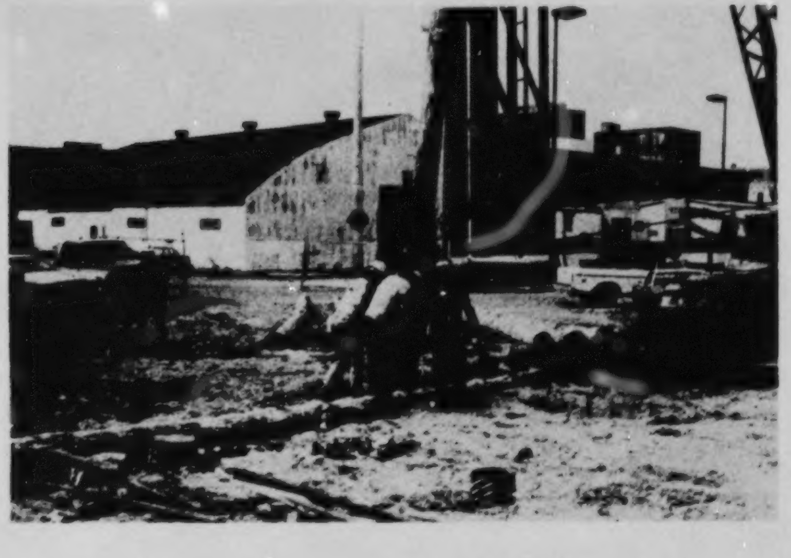
JOB SHEET #4

D. Raise hoist line to pull punch into cap of driver and secure punch into cap with attachment chains

E. Swing crane to position punch on top of stake (pile location) (Figure 50)

(NOTE: Punch is used to probe for and/or clear surface obstructions.)

FIGURE 50



F. Drive punch to required depth

G. Raise punch out of hole and swing crane to position punch on top of next stake

H. Drive punch to required depth

(NOTE: Continue punching in as many pile locations as can be reached from this location.)

I. Raise punch and lay aside (when all pile locations in this area are completed) out of way of operations

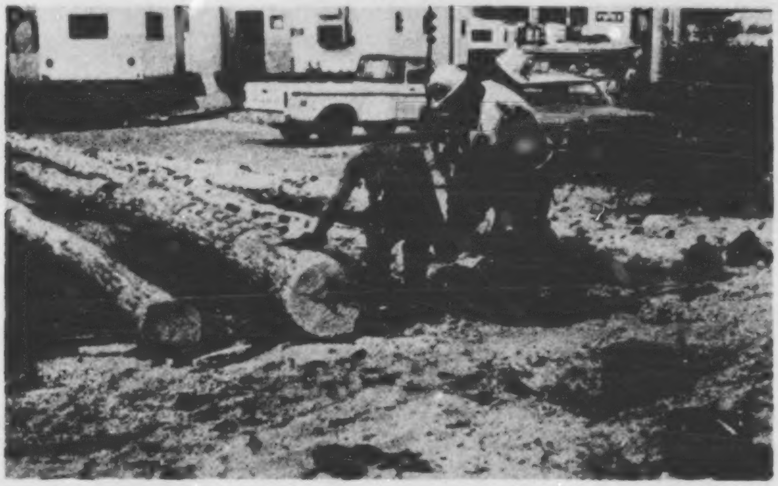
J. Swing boom to center hoist line over top end of pile and lower hoist line

JOB SHEET #4

K. Attach pile chain around top of timber piling within 1 1/2'-2' of head (Figure 51)

(NOTE: Ground crew will assist in making attachments.)

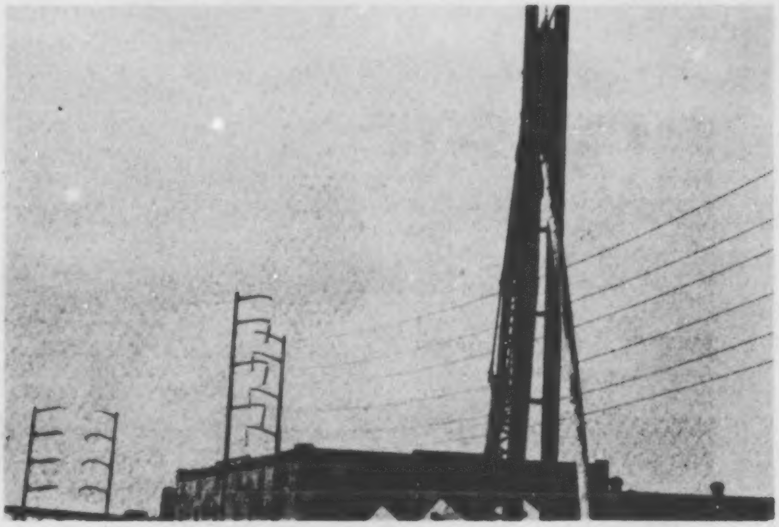
FIGURE 51



L. Raise pile up into leads and center under the cap; then, raise hammer and pile until pile is in a plumb position (Figure 52)

(NOTE: Ground crew will assist in aligning pile in the leads.)

FIGURE 52

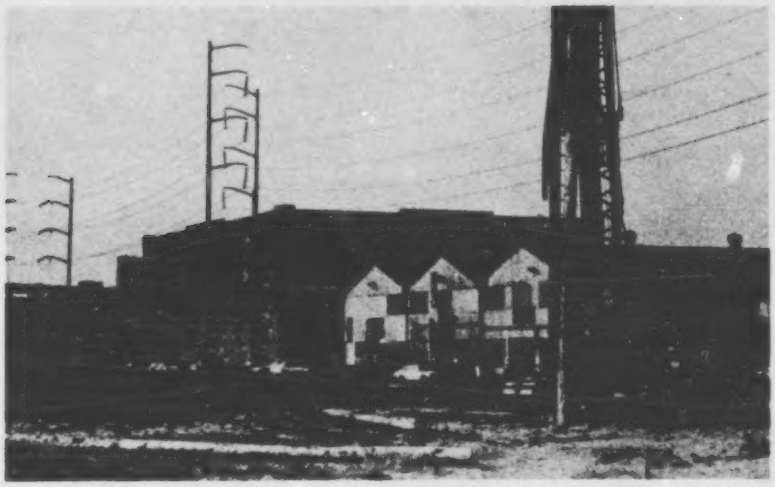


JOB SHEET #4

M. Position bottom of pile into punched hole or on pile stake and begin driving operations (Figure 53)

(NOTE: Allow enough slack in pile chain to allow chain to go down as pile is driven.)

FIGURE 53

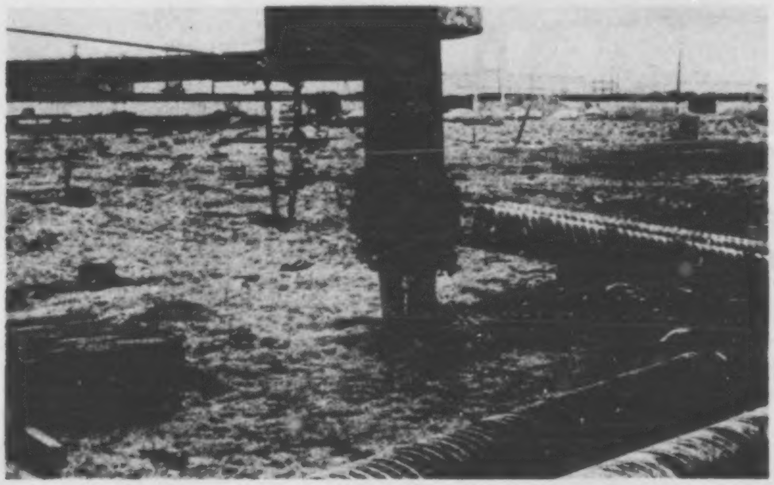


N. Maneuver crane and/or boom to keep pile and leads plumb

O. Release pile chain when top of pile is approximately ten feet from top of ground

P. Continue driving to proper depth (Figurs 54)

FIGURE 54



JOB SHEET #4

Q. Raise pile hammer in leads to clear top of the pile

R. Swing boom to pick up next pile

S. Lower hoist line, secure chain to pile and raise hammer in leads to about two-thirds of the height of the pile

T. Repeat driving operations until all piles are driven in this location

U. Swing boom to position hoist line over driving mandrel

V. Lower hoist line and attach mandrel

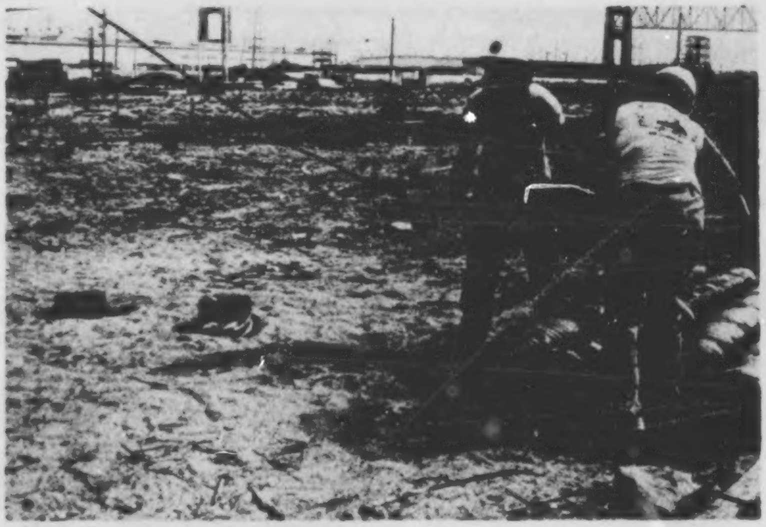
W. Raise hoist line to pull mandrel up into cap of driver

X. Secure mandrel to cap with attachment chains and release hoist line

Y. Swing boom to location of corrugated can and center hoist line

Z. Lower hoist line and attach to can (Figure 55)

FIGURE 55

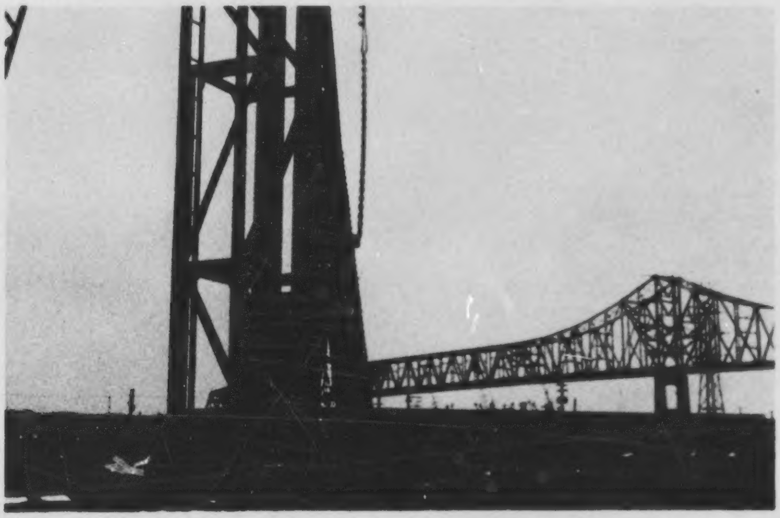


JOB SHEET #4

AA. Raise can up and onto mandrel (Figure 56)

(NOTE: It will probably be necessary for ground crew to help steady and work can onto mandrel and center on top of piling.)

FIGURE 56



BB. Lower hoist lines to lower hammer, mandrel, and can to position bottom of can on top of wooden piling as near center as possible (Figure 57)

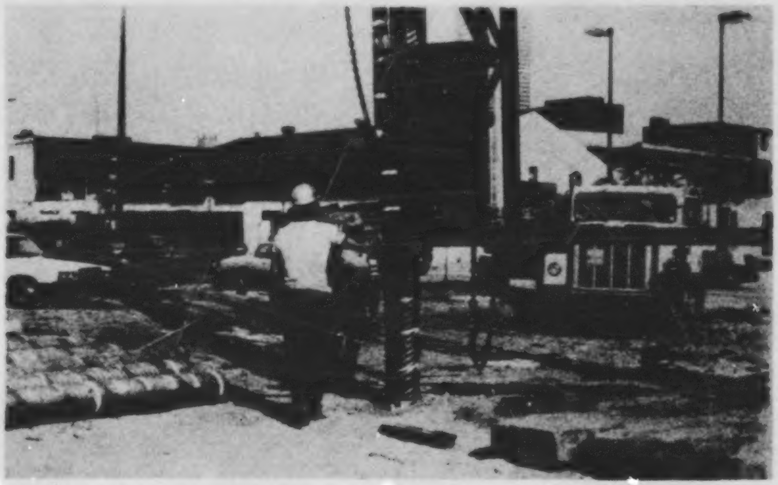
FIGURE 57

JOB SHEET #4

CC. Begin driving when signal is given (Figure 58)

(NOTE: Can will penetrate top of wooden piling until flange on can is resting on piling and crosspieces inside of can have imbedded in top of piling.)

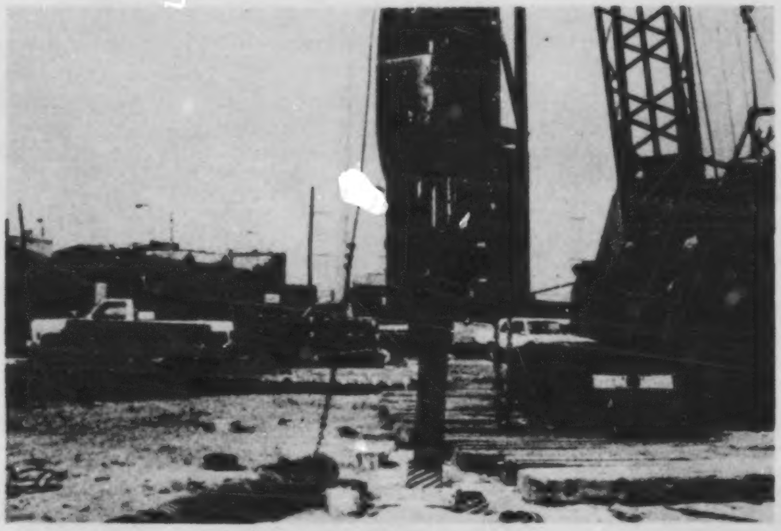
FIGURE 58



DD. Continue driving until can has been driven approximately three feet, then remove chain from can

EE. Continue driving can to proper elevation, then raise mandrel up and out of can (Figure 59)

FIGURE 59



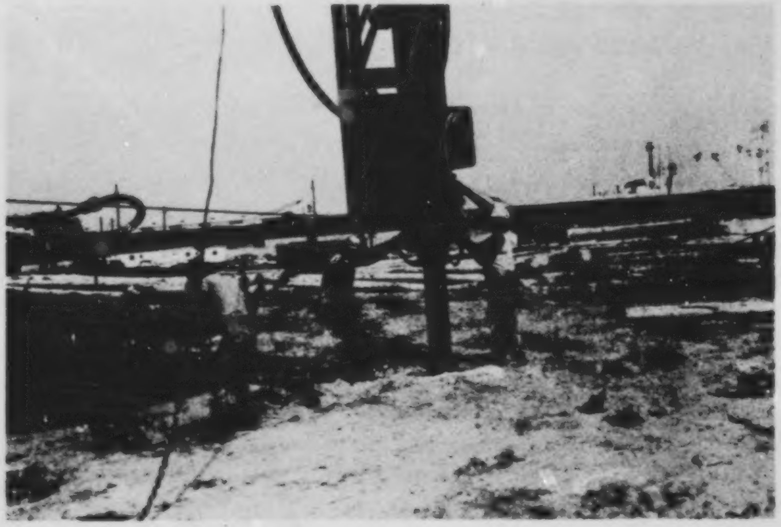
JOB SHEET #4

FF. Swing boom to center over next can; lower hoist line and attach chain to can

GG. Repeat operation of driving cans until all are set in this location (Figure 60)

(NOTE: After all piling and cans have been driven in this location, remove mandrel. Then, it will be necessary for crane to relocate mats and move to next location.)

FIGURE 60



PILE DRIVERS
(PILE HAMMERS)
UNIT V

JOB SHEET #5--DRIVE STEEL SHEET PILES

I. Equipment and materials

   A. Crane

   B. Hammer

   C. Steel sheet piling

II. Procedure

   (NOTE: When driving sheet piles for permanent structures, accuracy and good alignment must be maintained.)

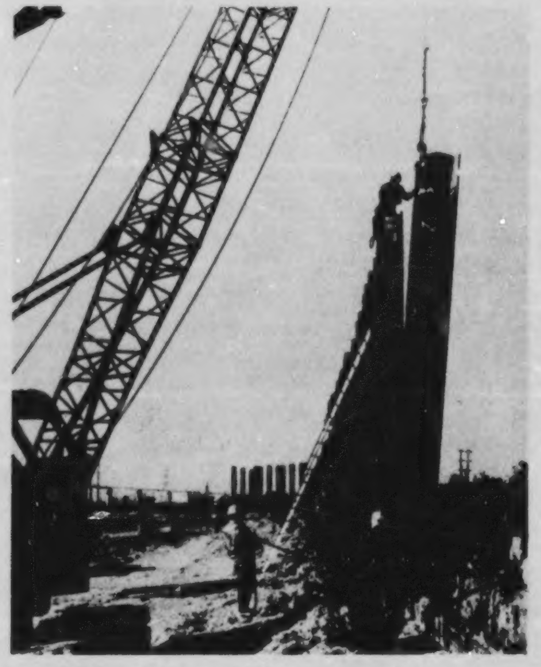
   A. Position crane for driving operations

   B. Swing boom to center hoist line over top end of pile

   C. Lower hoist line and attach with a set of clamps or with a cable through the hole in top of pile

   D. Raise pile up in a vertical position and set bottom in the correct location for driving (Figure 61)

FIGURE 61



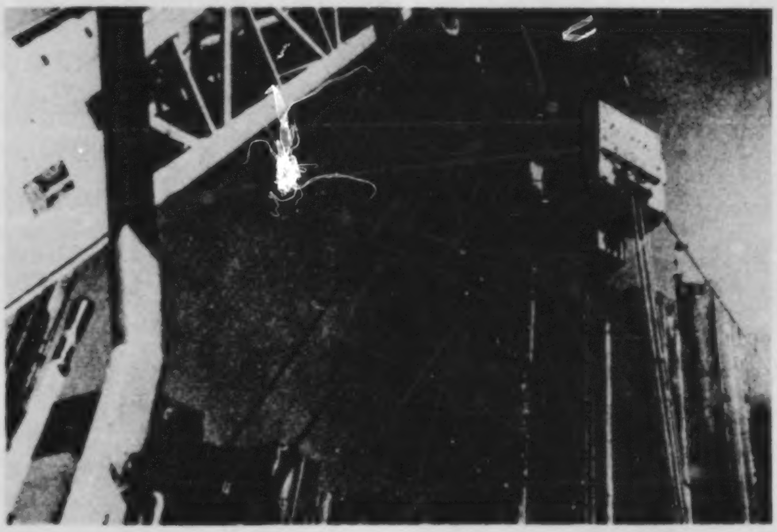
JOB SHEET #5

E. Raise hammer up and position cap on top of pile

F. Begin driving operations (Figure 62)

(NOTE: When starting sheet piling, apply short, light blows.)

FIGURE 62



G. Maneuver crane and/or boom to keep pile plumb in all directions

H. Continue driving approximately ten feet

(NOTE: Pile is left at this height to use as a guide for the following sheets, it also helps to keep pile plumb and aids in lining up the interlocks.)

(CAUTION: Be sure there is enough penetration in the ground to avoid damage by gusts of wind.)

I. Disconnect hoist line from pile and raise hoist line and hammer

J. Swing boom to center hoist line over top end of next pile

K. Lower hoist line and attach to pile

L. Raise pile in a vertical position, and maneuver the pile so that the interlocks line up properly

(NOTE: Ground crew will assist in setting and lining up the interlocks. Sometimes the crew will work from top of first pile or from a platform on a set of swinging leads.)

JOB SHEET #5

M. Lower hammer until cap is seated on pile; then begin driving operations

N. Maneuver crane and/or boom to keep pile plumb in all directions

O. Continue driving until top of pile is even with first pile

P. Move to next pile and repeat operations

Q. Continue driving until complete line of piles is set; then work back, driving piles another ten feet

(NOTE: This method tends to keep piling plumb and interlocks lined up.)

R. Continue these procedures until all the piling has been driven to grade

PILE DRIVER
(PILE HAMMERS)
UNIT V

TEST

NAME ______________________________ SCORE ______________

1. List three uses of pile drivers.

   a. ____

   b. ____

   c. ____

2. Match terms associated with pile drivers to their correct definitions. Write the correct numbers in the blanks. Terms and definitions are continued on the next two pages.

_____a. Support beams, slabs, or columns of wood, steel, or concrete placed in the soil for the purpose of transmitting a load through water, or strata of poor bearing capacity, to a stratum of adequate bearing capacity

_____b. A machine with hoisting apparatus, leads, and frame, for handling and driving piles

_____c. A sheetlike mass of sedimentary rock or earth of one kind lying between beds of other kinds

_____d. Pile made up of different materials, usually concrete and wood or steel fastened together end to end, to form a single pile

_____e. Vertical hanging beam that guides the hammer and pile

_____f. Steel cap placed over driving end of a pile to prevent damage during driving and to distribute impact of hammer evenly over the head of the pile

_____g. Intensity of the force, developed per unit area within a body, in resisting the forces acting on it

_____h. A member placed between the pile and hammer when head of pile is to be driven deeper than hammer can reach

_____i. Lining of a shaft

1. Composite pile
2. Pile driver
3. Drive cap
4. Strata
5. Piling
6. Stress
7. Leads
8. Cribbing
9. Follower

TEST

_____j. Stout, wooden lever with an adjustable steel hook near the lever end; usually used for handling logs

_____k. Crushing and spreading of the top of a wooden pile without a driving band when it is driven into hard ground

_____l. Beveling the edges of the heads of wooden piles

_____m. Horizontal brace used to hold timbers in place against sides of excavation or pile wall

_____n. An anchor for a guy wire

_____o. Line used between deadmen and sheeting to support the structure; also, a line used to hold and/or steady a high structure

_____p. A system of members which connect frames or panels laterally to make a continuous structure

_____q. Process of injecting grout (sand, cement, and water mixture) into forms and/or interlocking joints for the purpose of stabilization and water tightness

_____r. Somewhat watertight enclosure within which excavation can proceed to a firm foundation

_____s. Safety line used to hold and/or steady a load while being hoisted

_____t. Block at the base of a strut or brace

_____u. Point when piling will not go any deeper; may indicate specified minimum penetration per blow

_____v. Curved or horizontal beam attached to the pile driver in a way that permits swinging and holding the leads for driving batter piles at an angle to the machine

_____w. Leaning piles; used to carry substantial lateral loads

_____x. Used to prevent wear and absorb shock on places such as bridge piers and docks

10. Cross bracing
11. Brooming
12. Waler
13. Grouting
14. Tagline
15. Cant hook
16. Guy line
17. Dead man
18. Foot block
19. Chamfering
20. Cofferdam
21. Batter piles
22. Refusal
23. Fender piles
24. Moon beam

TEST

_____ y. Supporting piles for structures; bearings are reached by point bearing, friction, or friction and compaction

_____ z. Used to fasten tieback rods to hold seawalls in true lines against ground pressure; also used for anchoring high towers

_____ aa. Temporary pile used to support falsework in construction of bridges or to support steel beams on bridge structures until they are connected

_____ bb. Cluster of pile driven on a batter and bound together at the top

_____ cc. Leads underslung from a crane boom or extended beyond head of boom, holding the pile in true alignment while driving; standard fixed leads are slung from boom point with braces running from bottom of leads to crane frame

_____ dd. Leads suspended at the top to permit vertical or lateral movement or swinging through an arc; permits coverage of a wider area in one setup

_____ ee. Placing of timbers between H piles to increase frictional area in the soil

_____ ff. Long, tubular-type tool made to fit inside a casing to drive piling and/or drive casings; some are made with points on one end and are driven into the ground to form pilot holes for piling

_____ gg. Type of ram that uses pressure on underside to raise it, and is then allowed to fall by means of gravity

_____ hh. Type of ram with a closed top cylinder, into which the rising ram compresses air, imparting extra drive to the downstroke of the ram

25. Swinging leads (flying leads)
26. Single-acting hammer
27. Fixed leads
28. Double-acting hammer
29. Anchor piles
30. False pile
31. Bearing piles
32. Dolphine pile
33. Lagging
34. Mandrel

TEST

3. Name basic types of pile drivers.

a. ______________________________

b. ______________________________

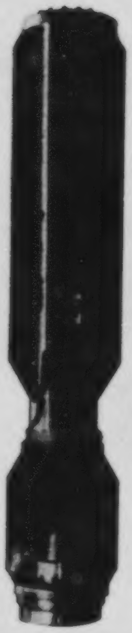
c. ______________________________

d. ______________________________

e. ______________________________

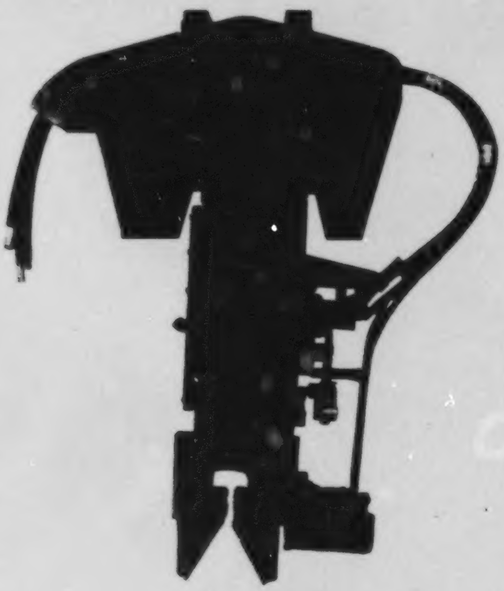
4. Identify types of pile hammers. Write the correct names in the blanks.

Diesel double-acting	**Diesel single-acting**
Variable stroke steam/air single-acting	**Hydraulic vibratory driver/extractor**
Steam/air double-acting	**Sonic**



a. ____________________

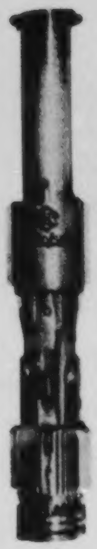
____



b. ____________________

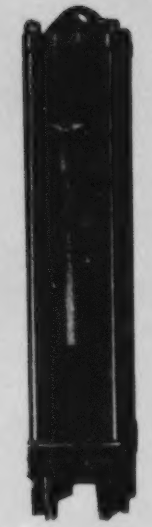
____

TEST



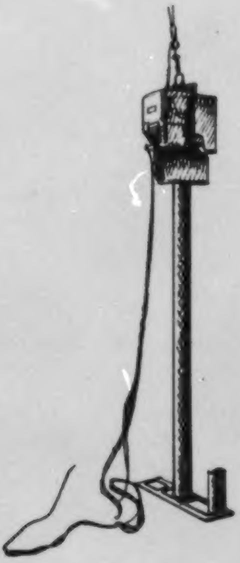
c. ____________________

____



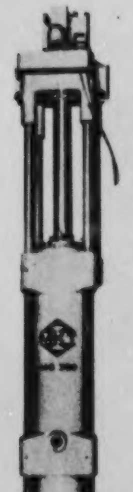
d. ____________________

____



e. ____________________

____



f. ____________________

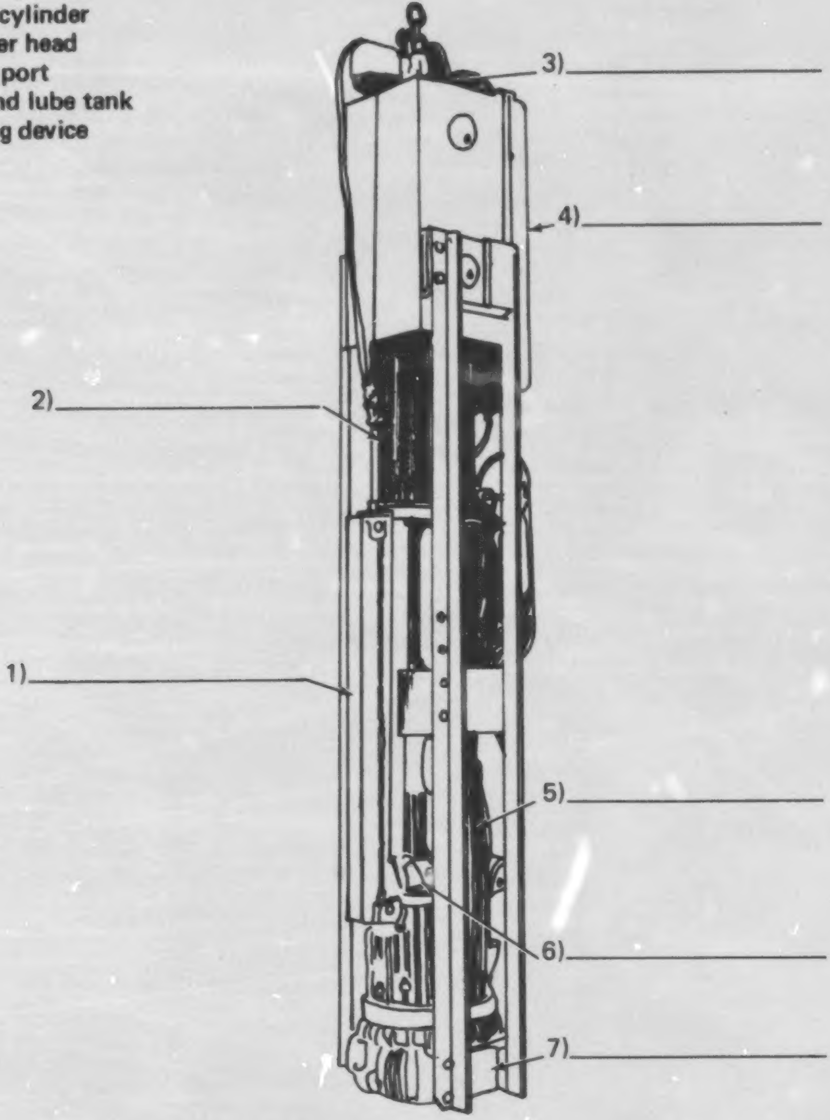
____

TEST

5. Identify basic parts of a diesel pile hammer. Write the correct names in the blanks.

   a. Right rear, three-quarter view

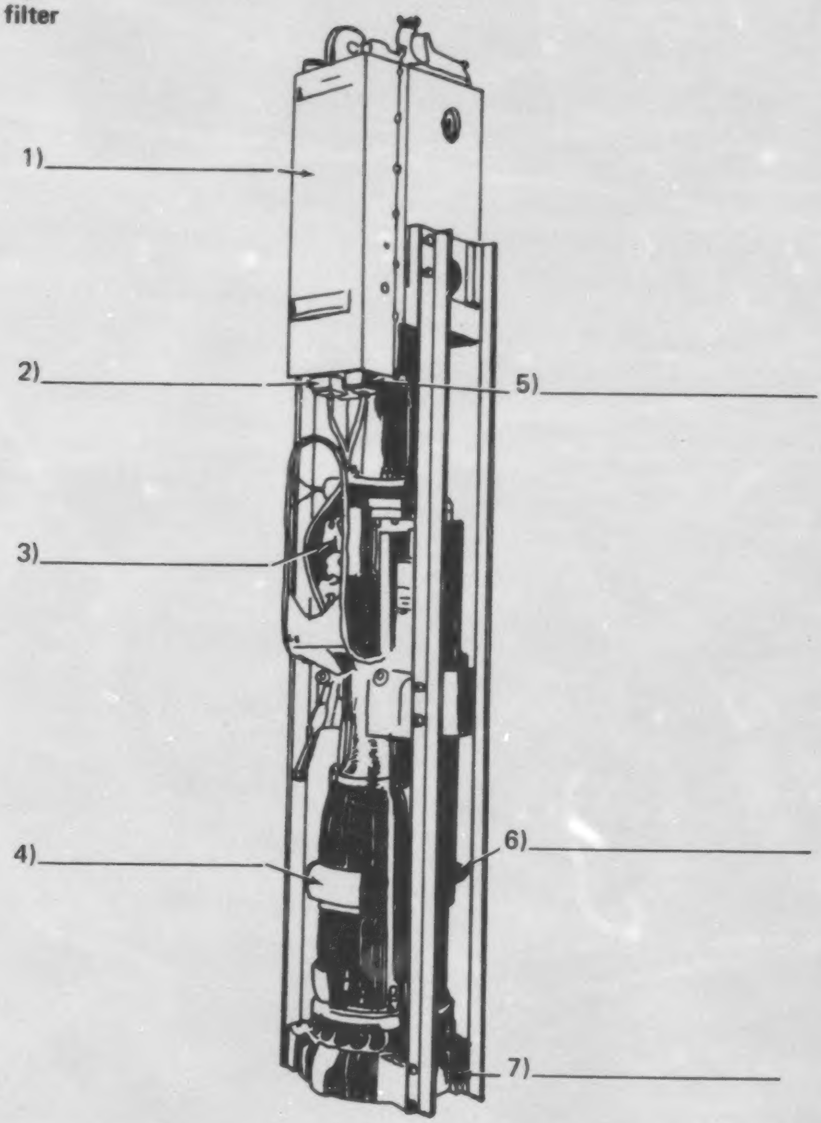
      Anvil guide
      Lower cylinder
      Upper cylinder
      Cylinder head
      Intake port
      Fuel and lube tank
      Starting device



TEST

b. Left front, three-quarter view

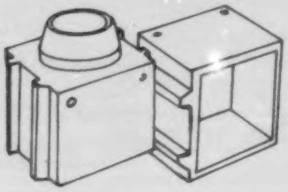
Lube filter
Exhaust port
Fuel and lube tank
Anvil guide
Pump driving mechanism
Intake port
Fuel filter



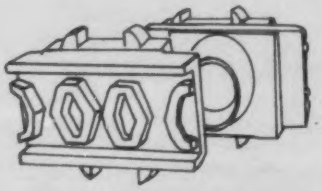
TEST

6. Identify types of driving heads used on piles. Write the correct names in the blanks.

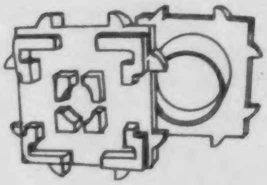
H beam
Pedestal (for concrete piles with extending reinforced rods)
Round and square flat face (for limited driving of all types of piles)
Pipe
Concrete
Steel sheet
Wood



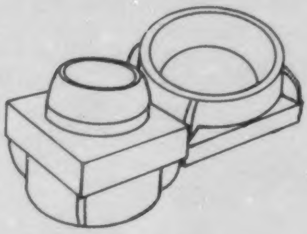
a. ______________________________



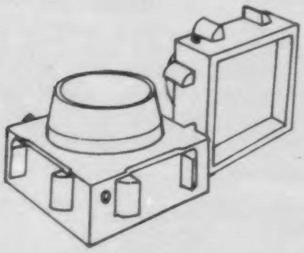
b. ______________________________



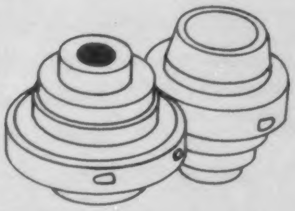
c. ______________________________



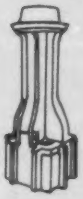
d. ______________________________



e. ______________________________



f. ______________________________



g. ______________________________

TEST

7. List seven types of piles.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

8. Select from the following list auxiliary equipment used on or with pile drivers. Write an "X" in the blank before each correct answer.

_____a. Cribbing

_____b. Cant hooks

_____c. Jacks

_____d. Ladder jacks

_____e. Scaffolds

_____f. Shores

_____g. Followers

_____h. Woven rope or wood block cushions

_____i. Sledge hammers

_____j. Chains and cables

_____k. Wooden mauls

_____l. Anvils

_____m. Drive caps

TEST

9. State five conditions that contribute to pile extraction hazards.

a. ______________________________

b. ______________________________

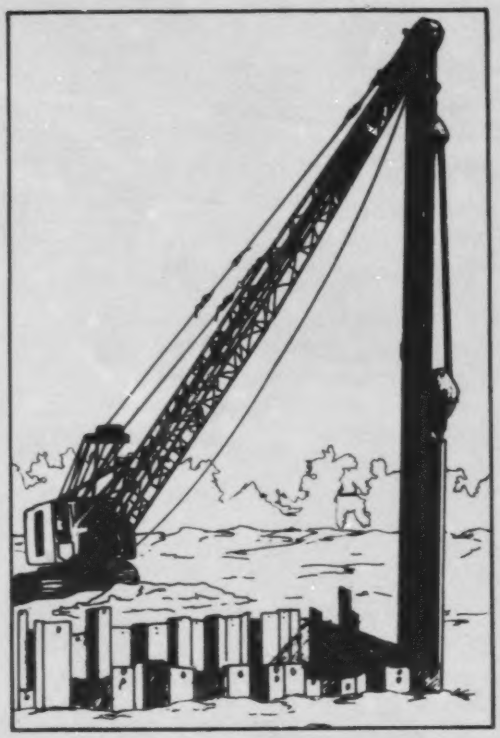
c. ______________________________

d. ______________________________

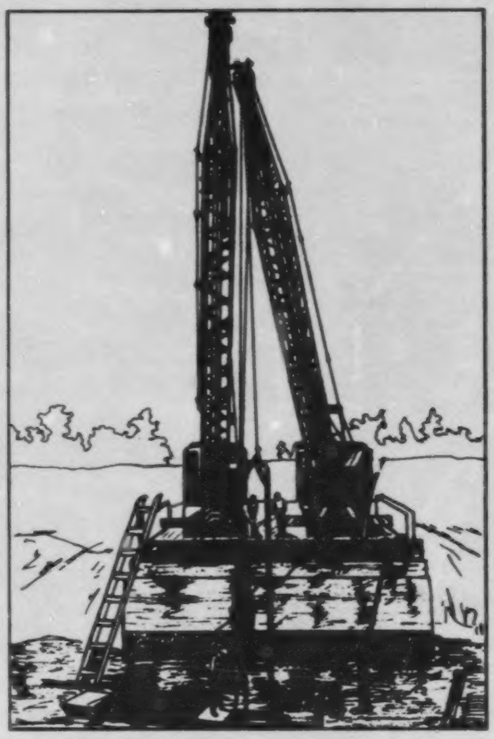
e. ______________________________

10. Identify methods and/or equipment used for pile extraction. Write the correct names in the blanks.

Extracting hammer
Vibratory type with clamp
Sonic
Wood pile extractor
Vibratory
Crane with pulling stick
Pulling pile, using extractor and jetting
Hooks fastened through holes, rings, or shackles in top of pile

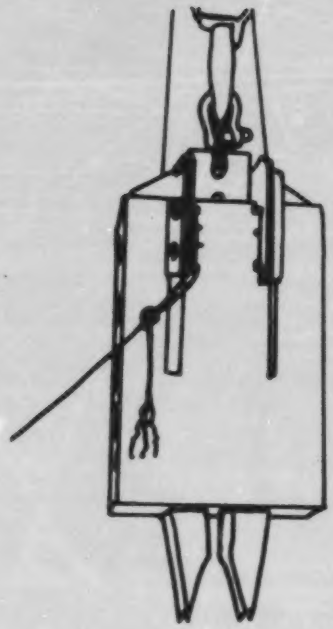


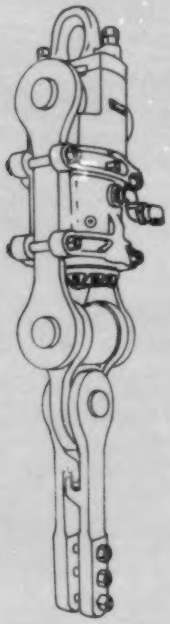
a. ______________________



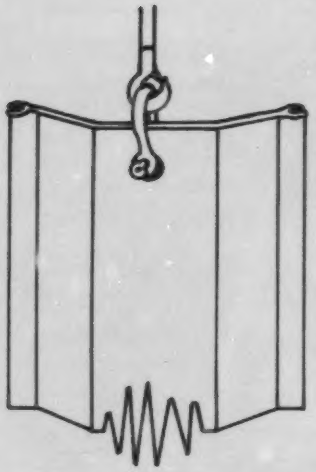
b. ______________________

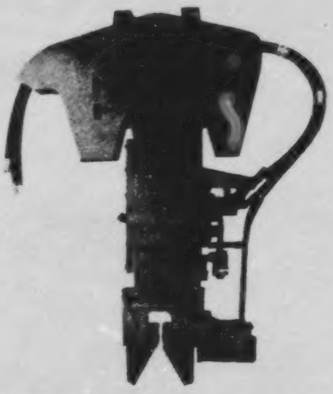
TEST





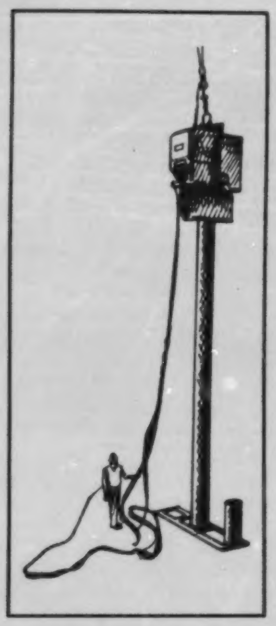
c. ____________________ d. ____________________

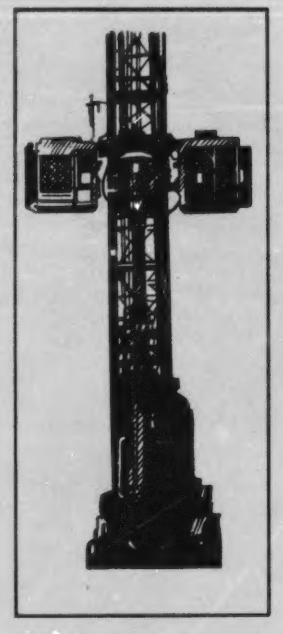




e. ____________________ f. ____________________

TEST

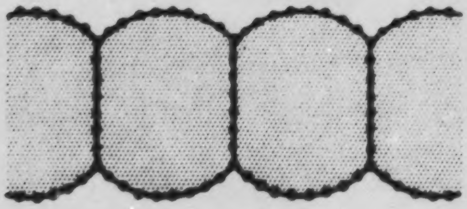


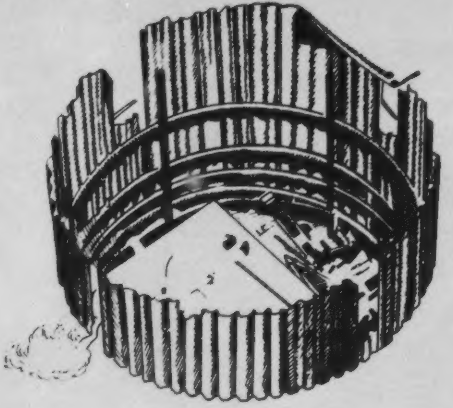


g. ______________________ h. ______________________

11. Identify types of cofferdams. Write the correct names in the blanks.

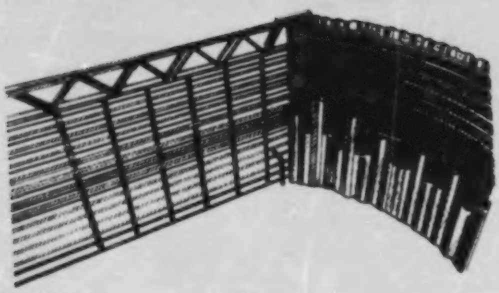
Slanted arc wall	Diaphragm type with cross bracing
Circular with rib bracing	Cellular rib braced and interconnected



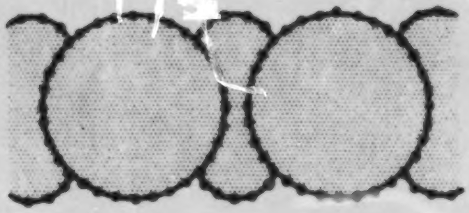


a. ______________________ b. ______________________

TEST



c. ____________________



d. ____________________

12. State twelve safety rules related to pile driving.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

i. ____________________

j. ____________________

k. ____________________

l. ____________________

13. State four suggestions for effective pile driving operations.

a. ____________________

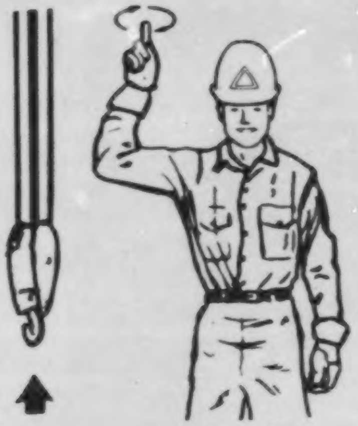
b. ____________________

c. ____________________

d. ____________________

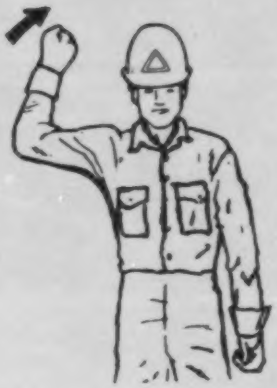
TEST

14. Label hand signals commonly used with pile drivers. Write the correct answers in the blanks.



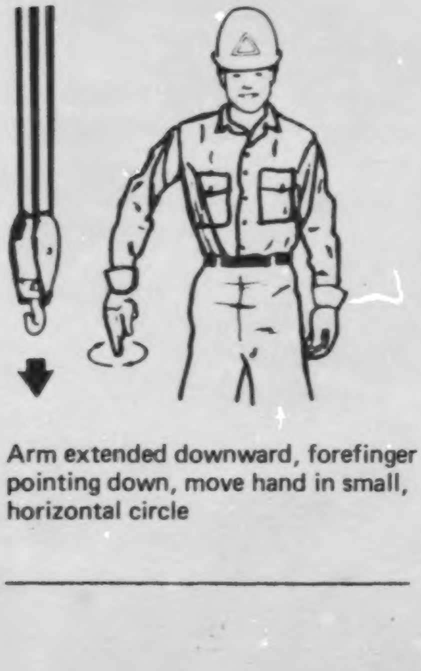
Forearm vertical, forefinger pointing up, move hand in small, horizontal circle

a. ______________________



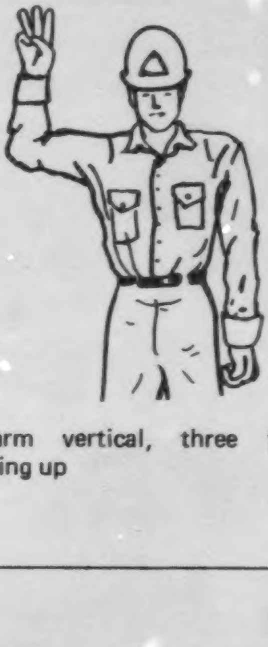
Forearm vertical, fist up

b. ______________________



Arm extended downward, forefinger pointing down, move hand in small, horizontal circle

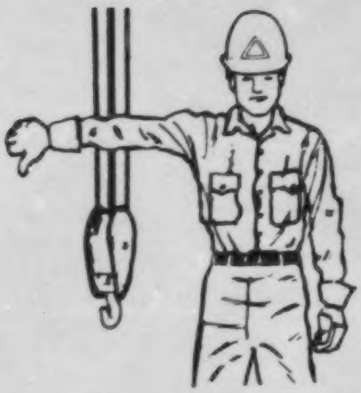
. ______________________



Forearm vertical, three fingers pointing up

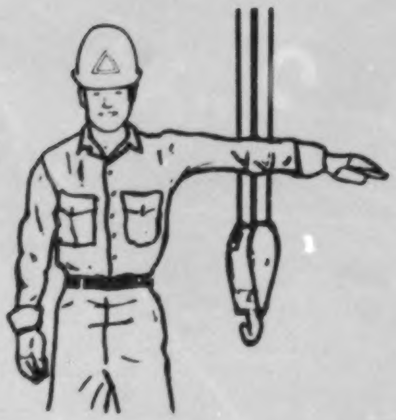
d. ______________________

TEST



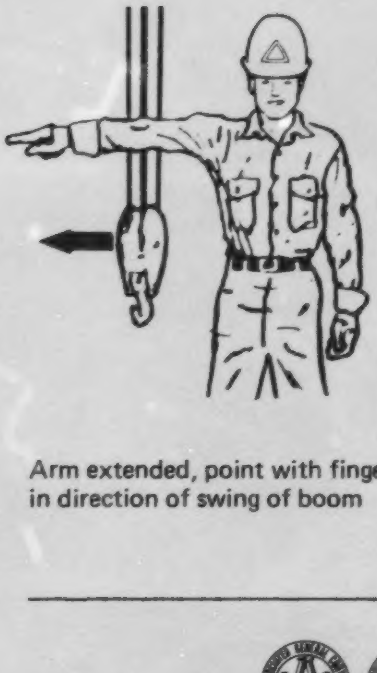
Arm extended, fingers closed, thumb pointing downward

e. ______________________________



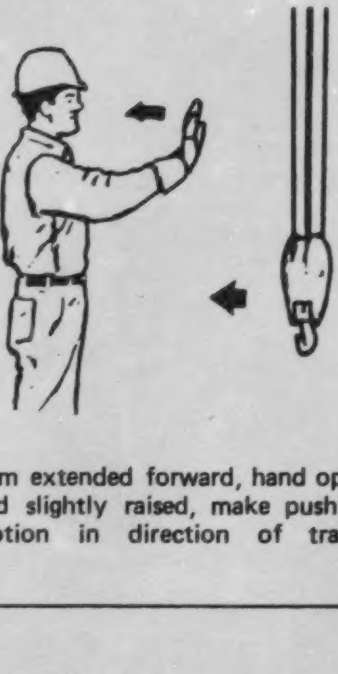
Arm extended, palm down, hold position rigidly

f. ______________________________



Arm extended, point with finger in direction of swing of boom

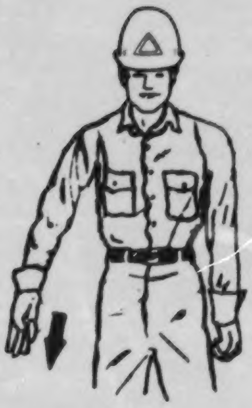
g. ______________________________



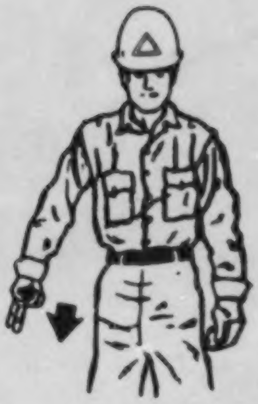
Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel

h. ______________________________

TEST

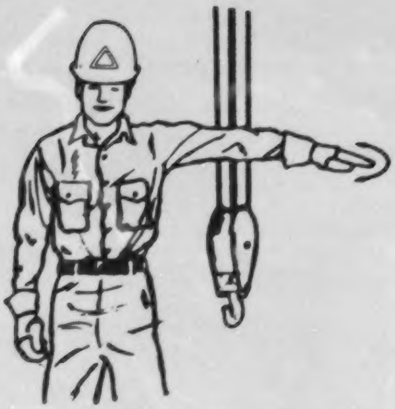


Arm extended downward, three fingers pointing down

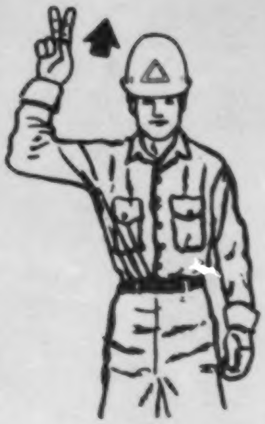


Forearm down, two fingers pointing down

i. ______________________ j. ______________________



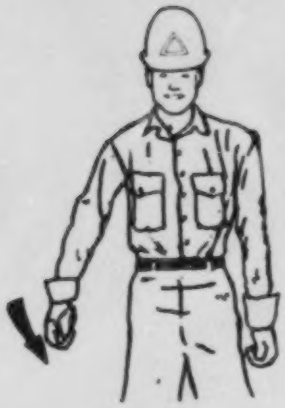
Arm extended, palm down, move hand rapidly right and left



Forearm vertical, two fingers pointing up

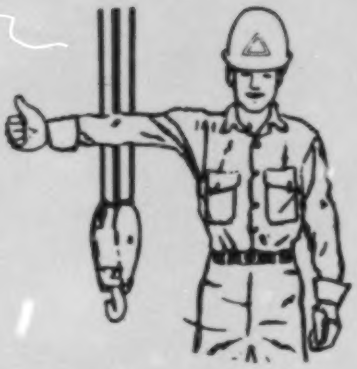
k. ______________________ l. ______________________

TEST



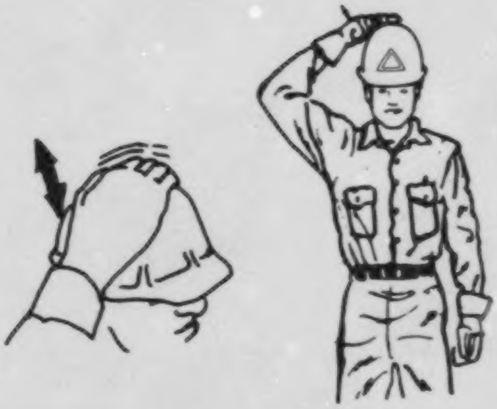
Arm extended downward, fist down

m. ______________________________



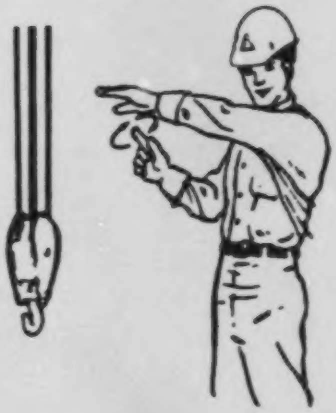
Arm extended, thumb pointing up, flex fingers in and out as long as movement is desired

n. ______________________________



Tap top of hat with palm of hand

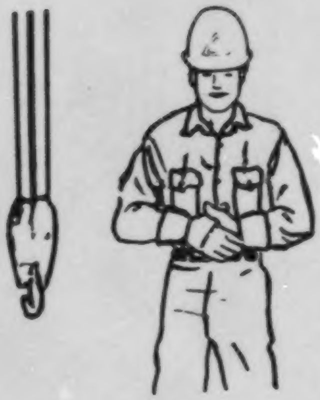
o. ______________________________



Place one hand motionless in front of hand giving the motion signal

p. ______________________________

TEST



Clasp hands in front of body

q. ______________________________

(NOTE: Test question 15 lists job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

15. Demonstrate the ability to

    a. Perform daily inspection on a diesel pile driver.

    b. Drive wooden piles.

    c. Drive steel H piles.

    d. Drive composite piles (wood and concrete).

    e. Drive steel sheet piles.

PILE DRIVERS
(PILE HAMMERS)
UNIT V

ANSWERS TO TEST

1. Answer should include any three of the following
   a. Drive piling to form continuous walls that will resist pressure from earth or water
   b. Drive piling for cutoff walls under structures to retard water flow
   c. Drive piling for load bearing
   d. Drive piling for retaining walls

2. a. 5
   b. 2
   c. 4
   d. 1
   e. 7
   f. 3
   g. 6
   h. 9
   i. 8
   j. 15
   k. 11
   l. 19
   m. 12
   n. 17
   o. 16
   p. 10
   q. 13
   r. 20
   s. 14
   t. 18
   u. 22
   v. 24
   w. 21
   x. 23
   y. 31
   z. 29
   aa. 30
   bb. 32
   cc. 27
   dd. 25
   ee. 33
   ff. 34
   gg. 26
   hh. 28

3. a. Drop
   b. Steam or air
   c. Diesel
   d. Hydraulic
   e. Sonic or vibratory

4. a. Diesel double-acting
   b. Hydraulic vibratory driver/extractor
   c. Diesel single-acting
   d. Steam/air double-acting
   e. Sonic
   f. Variable stroke steam/air single-acting

ANSWERS TO TEST

5. a. Right rear, three-quarter view
   1) Starting device
   2) Upper cylinder
   3) Cylinder head
   4) Fuel and lube tank
   5) Lower cylinder
   6) Intake port
   7) Anvil guide

   b. Left front, three-quarter view
   1) Fuel and lube tank
   2) Fuel filter
   3) Pump driving mechanism
   4) Exhaust port
   5) Lube filter
   6) Intake port
   7) Anvil guide

6. a. Concrete
   b. Steel sheet
   c. H beam
   d. Wood
   e. Round and square flat face (for limited driving of all types of piles)
   f. Pipe
   g. Pedestal (for concrete piles with extending reinforced rods)

7. Answer should include any seven of the following
   a. Timber
   b. Cast-in-place concrete
   c. Precast concrete
   d. Steel H pipe
   e. Steel pipe
   f. Composite
   g. Wood sheet
   h. Concrete sheet
   i. Steel sheet
   j. Tapered steel shell (monotube)

ANSWERS TO TEST

8. a, b, c, e, f, g, h, j, l, m

9. Answer should include any five of the following
    a. Deep penetration when originally installed
    b. Exposure to severe bending movement
    c. Damage which occurred during original driving
    d. Sand, rust, dirt, or other material lodged in the interlocks
    e. Locking action caused by grouting
    f. Piling which has been placed for a long time
    g. Loss of the screwbolt through vibration in extractor connections
    h. Cable and hook failure
    i. Ground friction

10. a. Crane with pulling stick
    b. Pulling pile, using extractor and jetting
    c. Wood pile extractor
    d. Extracting hammer
    e. Hooks fastened through holes, rings, or shackles in top of pile
    f. Vibratory type with clamp
    g. Sonic
    h. Vibratory

11. a. Diaphragm type with cross bracing
    b. Circular with rib bracing
    c. Slanted arc wall
    d. Cellular rib braced and interconnected

12. Answer should include any twelve of the following
    a. Inspect guy lines and leads frequently
    b. Inspect ladders, platforms, and scaffolding regularly

ANSWERS TO TEST

- c. Secure ends of steam and/or air hoses to prevent them from whipping
- d. Block hammers at base of leads to prevent them from falling when not in use
- e. Inspect all ropes, slings, chains, and blocks frequently
- f. Know and follow hand signals
- g. Wear protective clothing where and when required
- h. Use taglines when positioning pile in leads; keep hands and arms away from pile and guide, and off top of pile
- i. Keep working platforms clean
- j. Keep all incidental and auxiliary equipment in safe operating condition
- k. Keep pile leads securely bolted
- l. Inspect entire rig daily for loose parts
- m. Provide lifelines for personnel where necessary
- n. Wear life jackets when working on waterborne structures
- o. Provide lifelines and life rings on boats, trestles, barges, and other water equipment
- p. Keep boats handy for emergency use

13. Answer should include any four of the following
    - a. Start piles correctly
    - b. Do not try to bend piles
    - c. Keep hammer and leads free of burrs or other projections
    - d. Keep all equipment in good and safe operating condition
    - e. Use protective devices on piles during driving process
    - f. Perform maintenance regularly

14. a. Hoist load
    - b. Raise hammer
    - c. Lower load

ANSWERS TO TEST

d. No. 3 line up

e. Lower boom

f. Stop

g. Swing

h. Travel crane

i. No. 3 line down

j. No. 2 line down

k. Emergency stop

l. No. 2 line up

m. Lower hammer

n. Raise boom

o. Fire hammer

p. Move slowly

q. Dog everything

15. Performance skills evaluated to the satisfaction of the instructor

FORK LIFTS
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a fork lift safely and efficiently to perform required jobs. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of rough terrain fork lifts.
2. Match terms associated with fork lifts to their correct definitions.
3. Label basic components of a fork lift.
4. Label controls on a fork lift.
5. Identify accessories and/or attachments used on fork lifts.
6. State safety rules pertaining to fork lifts.
7. State suggestions for effective fork lift operations.
8. Select from a list items to check when servicing a fork lift.
9. Demonstrate the ability to
    a. Perform service on a fork lift.
    b. Start, warm up, and check gauges and performance of controls.
    c. Perform a basic unloading job.
    d. Stockpile material on a scaffold.
    e. Use a fork lift to set steel.

FORK LIFTS
UNIT VI

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information sheet.

  E. Demonstrate and discuss procedures outlined in job sheets.

  F. Stress to students that manipulation of controls and operating procedures may differ with different models and manufacturers.

  G. Provide other jobs if job sheets are not practical.

  H. Obtain operator's guides and service guides for particular machine being used for training.

  I. Give test.

II. Instructional materials

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Job sheets

    1. Job Sheet #1--Perform Service on a Fork Lift

    2. Job Sheet #2--Start, Warm Up, and Check Gauges and Performance of Controls

    3. Job Sheet #3--Perform a Basic Unloading Job

    4. Job Sheet #4--Stockpile Material on a Scaffold

    5. Job Sheet #5--Use a Fork Lift to Set Steel

  E. Test

  F. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. *Clark Operators Instructor's Manual.*

B. *John Deere JD480-B Forklift Operator's Manual.* OM-T69917 Issue No. Moline, Illinois: John Deere, n.d.

FORK LIFTS
UNIT VI

INFORMATION SHEET

I. Uses of rough terrain fork lifts (Figures 1, 2, and 3)

  A. Load and unload materials

  B. Transport materials on job site

  C. Hoist materials

FIGURE 1

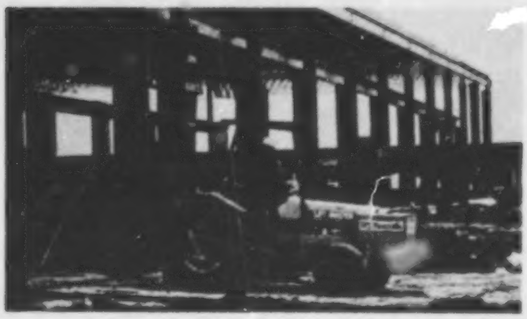


FIGURE 2

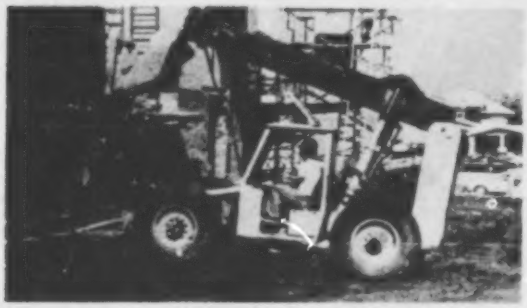
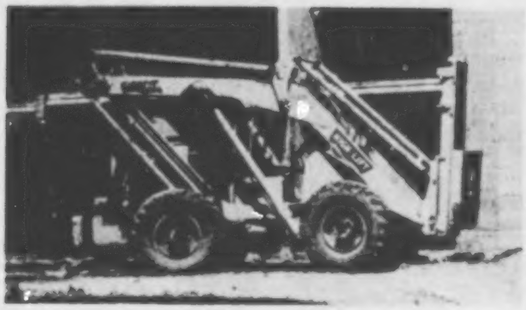


FIGURE 3



INFORMATION SHEET

II. Terms and definitions

  A. Rough terrain--Rough ground surface

  B. Pallet--A tray or platform used for stacking material

  C. Reservoir--Tank or basin used primarily for storage or collection of a liquid

  D. LP gas (liquefied petroleum gas)--Any material made up mostly of hydrocarbons, or mixtures of them such as propane, propylene, butane (normal butane or isobutane), and butylenes

  E. Dipstick--A graduated rod for indicating amount of oil or fluid in a system

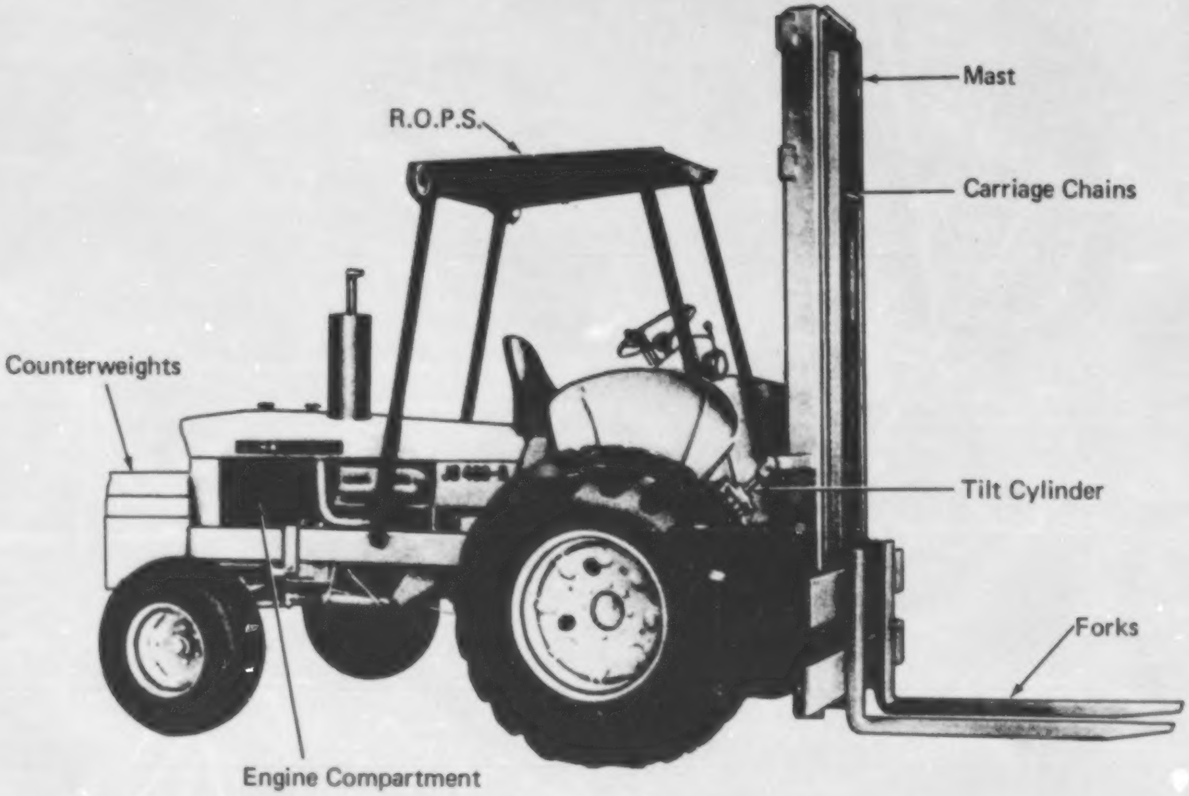
  F. Stockpile--Materials placed in a central area to be distributed later

  G. Cube--Stack of ninety blocks arranged four feet wide, four feet deep, and five blocks high

INFORMATION SHEET

III. Basic components of a fork lift (Figure 4)

FIGURE 4

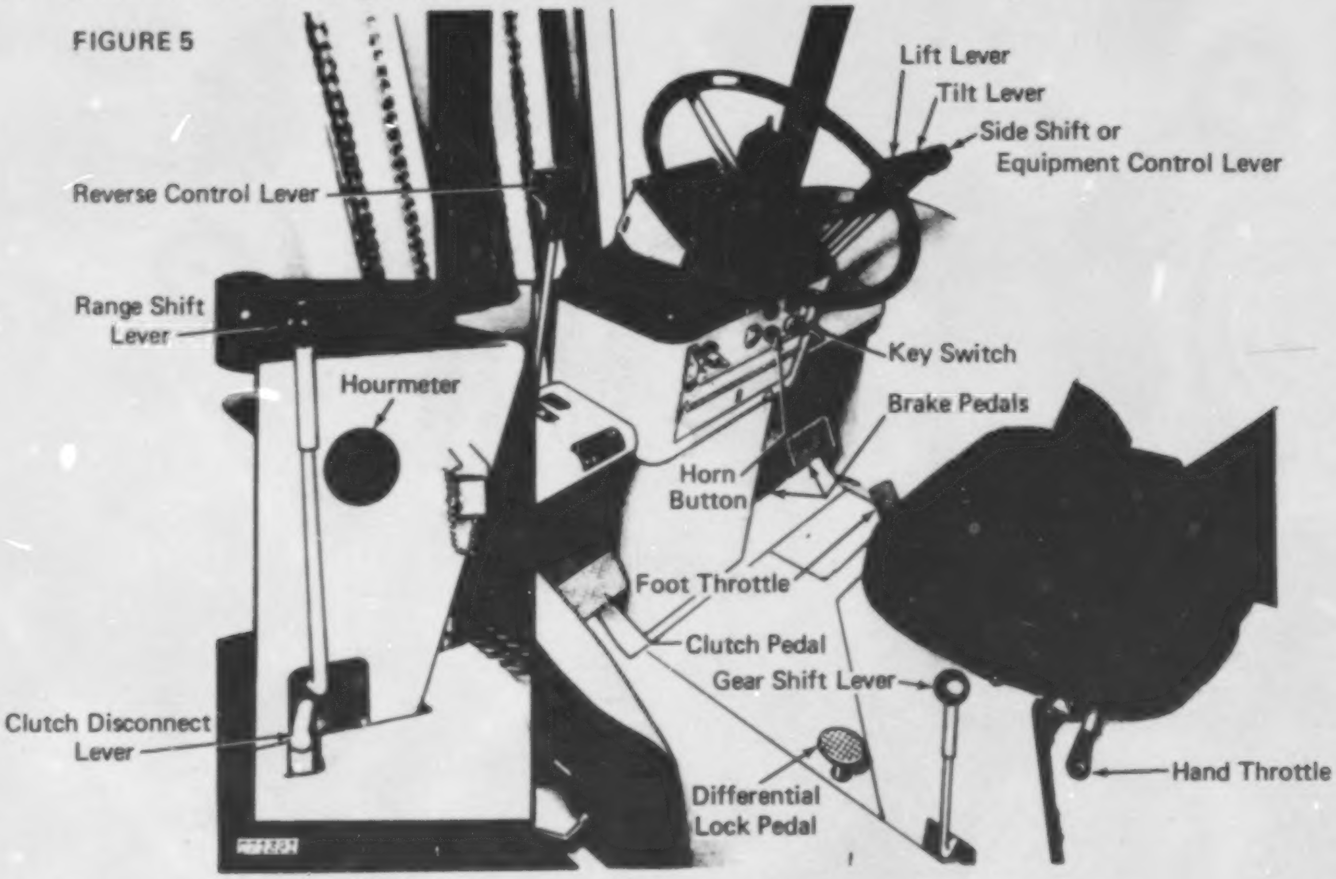

Mast
R.O.P.S.
Carriage Chains
Counterweights
Tilt Cylinder
Forks
Engine Compartment

Used with permission of Deere & Company.

INFORMATION SHEET

IV. Controls on a fork lift (Figure 5)

FIGURE 5


Lift Lever
Tilt Lever
Side Shift or Equipment Control Lever
Reverse Control Lever
Range Shift Lever
Hourmeter
Key Switch
Brake Pedals
Horn Button
Foot Throttle
Clutch Pedal
Gear Shift Lever
Clutch Disconnect Lever
Differential Lock Pedal
Hand Throttle

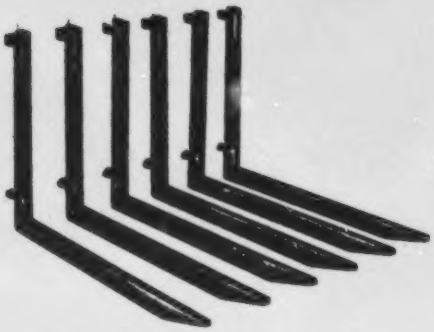
Used with permission of Deere & Company.

INFORMATION SHEET

V. Accessories and/or attachments used on fork lifts (Figures 6-10)

A. Concrete block tines

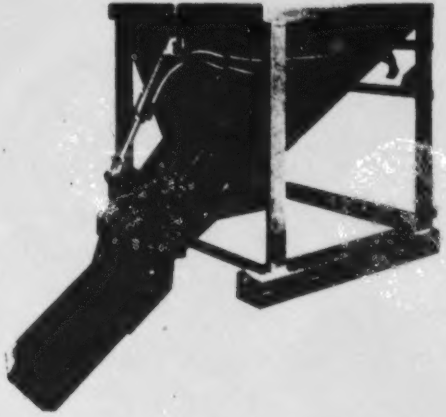
FIGURE 6



Courtesy of Deere & Company.

B. Mortar hopper

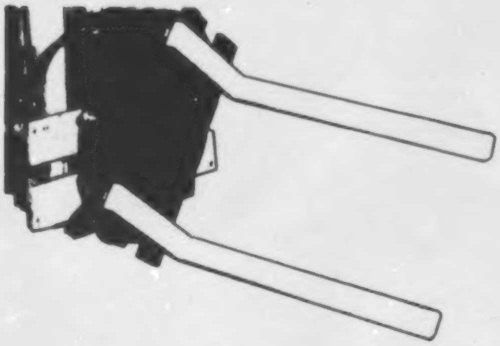
FIGURE 7



Courtesy of Deere & Company.

C. Rotator

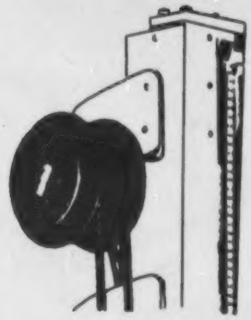
FIGURE 8



Courtesy of Deere & Company.

D. Hose reel

FIGURE 9

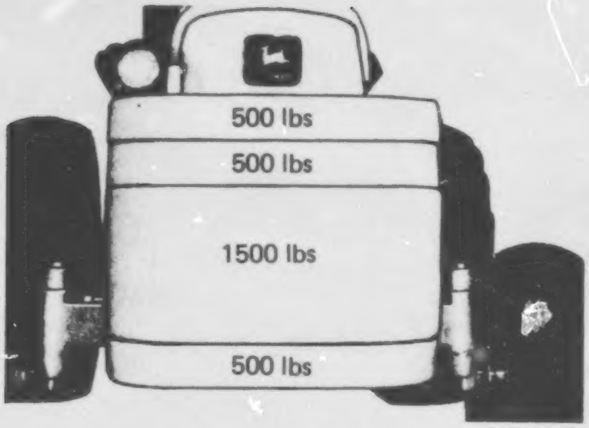


Courtesy of Deere & Company.

INFORMATION SHEET

E. Counterweights

FIGURE 10



Courtesy of Deere & Company.

VI. Safety rules pertaining to fork lifts

A. Wear protective clothing and safety devices required by job conditions

B. Never leave machine running unattended

C. Never mount or dismount while machine is moving

D. Never permit riders on machine

E. Use extreme caution on slopes and grades

F. Be sure load does not block view

G. Do not drive close to edges of ditches or excavations

H. Keep load as close to ground as possible when traveling

I. Use extreme caution around power lines

J. Lower fork to the ground when parking

K. Be sure all bystanders are clear before starting operations

L. Know and respond to hand signals given by signal person

M. Be sure all safety devices are functioning properly

INFORMATION SHEET

VII. Suggestions for effective fork lift operations

A. Set up work cycle so as to be as short as possible

B. Keep transport distance as short as possible

C. When transporting load, keep it just high enough to clear obstacles

D. Keep machine clean

E. Service machine regularly

F. Travel slowly and cautiously on rough ground

G. Operate engine at full throttle for maximum lift

H. Operate engine slower to place load smoothly

I. Adjust forks for each particular job

J. When stacking or unloading pallets, raise the top pallets slightly to keep them from catching on lower ones

VIII. Items to check when servicing a fork lift

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Visual inspection for broken, worn or missing parts, and leaks

B. Engine oil level, filter, lines, and hoses

C. Air cleaner filter (element), restriction indicator, and unloader valve

D. Engine coolant level, radiator cap, hose, and radiator

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Fuel level, fuel filters, and sediment bowl (where applicable)

F. Battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Exhaust system

H. Hydraulic fluid level, filters, hose, lines, fittings, and leaks

I. Transmission fluid level

INFORMATION SHEET

J. Transmission pressure line filter and breather

K. Brake adjustment and condition

L. Brake master cylinder fluid level

M. Clutch for proper adjustment

N. Drive belts for tension and wear

O. Wiring, insulation, and connections

P. Grease fittings

Q. Tire pressure and condition

R. Rear wheel bearings and retainer cap screws

S. All safety devices

T. Windshield wipers (where applicable)

U. Carriage chains for tension

V. Mast channels

W. Trunnion blocks

X. Gauges and controls for proper functioning

FORK LIFTS
UNIT VI

JOB SHEET #1--PERFORM SERVICE ON A FORK LIFT

I. Equipment and materials

(NOTE: Use manufacturer's service guide and recommendations for particular piece of equipment being serviced.)

A. Fork lift

B. Tool kit

C. Shop rags

D. Lubricants and fuel

E. Cleaning solvent

F. Baking soda solution

G. Electrolyte or water

H. Compressed air supply

I. Grease gun

J. Wire brush

K. Belt tension gauge

L. New parts where needed

M. Tire gauge

II. Procedure

A. Walk around equipment inspecting for broken, worn, or missing parts and leaks

(NOTE: Write down on pad any repairs that are needed.)

B. Remove dipstick, wipe clean, and replace

C. Remove dipstick again to check level of engine oil; add oil if necessary

D. Remove oil filter and check; clean with cleaning solvent if necessary and then replace

E. Check lines and hoses for damage and leaks

F. Squeeze unloader valve to remove dirt, if plugged

JOB SHEET #1

G. Check air filter; clean with compressed air or replace

H. Remove radiator cap to check fluid level; add coolant if necessary

CAUTION: Do not remove radiator cap unless engine is cool, then open slowly, to release pressure.)

I. Check radiator and hoses for leaks; clean trash from radiator

J. Check fuel level and fill if necessary; check filters, replace when necessary; release clamp from sediment bowl and remove, clean, and replace

K. Remove filler caps from battery (where applicable) and check electrolyte level; fill if necessary; use electrolyte or water to fill, then replace filler caps

L. Use a wire brush to clean battery terminals and connectors, if battery is dirty wash with a baking soda solution then apply an anti-corrosion paste to the terminals and connectors

(CAUTION: Keep sparks and fire away from battery.)

M. Check exhaust system for hose connections or holes

N. Check hydraulic fluid level; fill if necessary

O. Remove hydraulic filters, clean if necessary, then replace

P. Check hydraulic system for leaks

Q. Remove dipstick from transmission, wipe clean then replace; remove dipstick again to check level of fluid; add fluid if necessary

R. Check filter and breather; clean or replace as necessary

S. Remove pipe plug from each wheel; install grease fittings and lubricate

(NOTE: When operating in extremely wet and muddy conditions, rear wheel bearings should be lubricated daily.)

T. Remove grease fittings and replace pipe plug

U. Check tire pressures and condition

V. Check brakes and their adjustment; adjust, or replace when necessary

W. Remove plug from brake master cylinder and check fluid level; add fluid if needed

X. Check clutch for proper adjustment; adjust when necessary

Y. Check drive belts for wear and tension; adjust or replace as necessary

JOB SHEET #1

Z. Visually check all wiring, insulation, and connections; make repairs as necessary

AA. Wipe all grease fittings clean; using lubricant recommended by manufacturer, lubricate all fittings

BB. Check condition of all safety devices; make sure all safety devices are functioning properly

CC. Lubricate control levers

DD. Clean machine inside and out

EE. Check carriage chains for proper tension; if necessary, adjust tension by loosening jam nuts on lift chain eyebolts, then turning eyebolts in or out to obtain desired tension

FF. Retighten jam nuts when desired tension is obtained

(NOTE: Tension should be the same on all chains.)

GG. Use cleaning solvent and small paint-type brush to clean mast channels

HH. Use brush and multi-purpose grease to lubricate mast channels

II. Remove dust caps from sprocket bearing grease fittings; lubricate with multi-purpose grease; reinstall dust caps

JJ. Clean trunnion block grease fitting and lubricate with multi-purpose grease

FORK LIFTS
UNIT VI

JOB SHEET #2--START, WARM UP, AND CHECK GAUGES AND PERFORMANCE OF CONTROLS

I. Equipment and materials

A. Fork lift

B. Fork or other accessory or attachment

II. Procedure

A. Mount machine

B. Move range shift lever to neutral or park

C. Push down brake pedals

D. Move hand throttle to 1/3 speed

E. Turn the key to start engine

(NOTE: Do not crank engine more than 20 seconds; if engine fails to start, wait about 2 minutes, then try again.)

F. Release key when engine starts

G. Move throttle to half-speed position

H. Warm up engine for 5 minutes

I. Make sure all gauges and instruments are functioning properly

J. Check for unusual noises and vibrations

K. Shift gears to low range

L. Release brake

M. Check for proper operation of service brakes

N. Check for proper operation of steering

O. Manipulate controls to raise and lower fork

P. Manipulate controls to tilt fork forward and backward

Q. Manipulate controls to raise and lower mast (boom)

R. Manipulate controls to operate hydraulic accessories and/or attachments

JOB SHEET #2

S. Shift gears to neutral and lock

T. Reset brake

U. Move throttle to idle

V. Turn key off

W. Dismount machine

X. Make final visual check for leaks

FORK LIFTS
UNIT VI

JOB SHEET #3--PERFORM A BASIC UNLOADING JOB

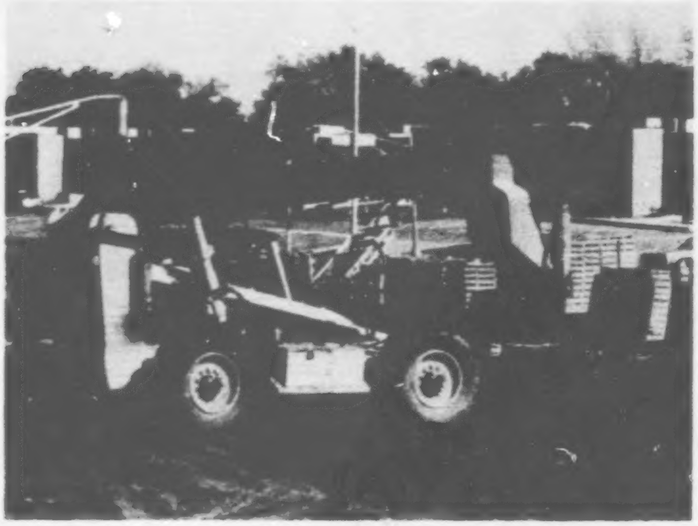
I. Equipment and material

A. Fork lift (Figure 11)

B. Truck

C. Load of brick

FIGURE 11



II. Procedure

A. Mount fork lift and start engine

B. Raise fork to clear obstructions

C. Proceed to truck

D. Approach truck from rear; at same time raise fork so that it is close to correct height for unloading

E. Stop just short of truck so that fork can be adjusted to correct width and height to slide into slots in cube of brick

JOB SHEET #3

F. Move forward slowly and make minor adjustments of fork, as necessary

G. Raise fork slightly (enough to clear lower cube) and move in reverse at the same time

H. Tilt boom back slightly when cube is clear of other bricks and raise fork to clear rear of truck

(CAUTION: Excessive tilt could cause bricks to shift and fall.)

I. Continue reverse movement until fork is clear of truck

J. Lower load just so fork will clear obstacles

K. Proceed to location of brick stockpile

(NOTE: Be sure stockpile location is clear of all debris and is fairly level so that bricks may be stacked in a uniform and safe stack.)

L. Move to correct location; lower load to the ground and tilt boom forward to a level position at the same time

M. Adjust fork so that it is clear of bricks

N. Place fork lift in reverse and back away from cube

O. Raise fork to clear obstacles and proceed back to truck

P. Continue this procedure until truck is unloaded

(NOTE: It may be necessary to approach truck from the sides instead of the rear in order to completely unload truck.)

FORK LIFTS
UNIT VI

JOB SHEET #4--STOCKPILE MATERIAL ON A SCAFFOLD

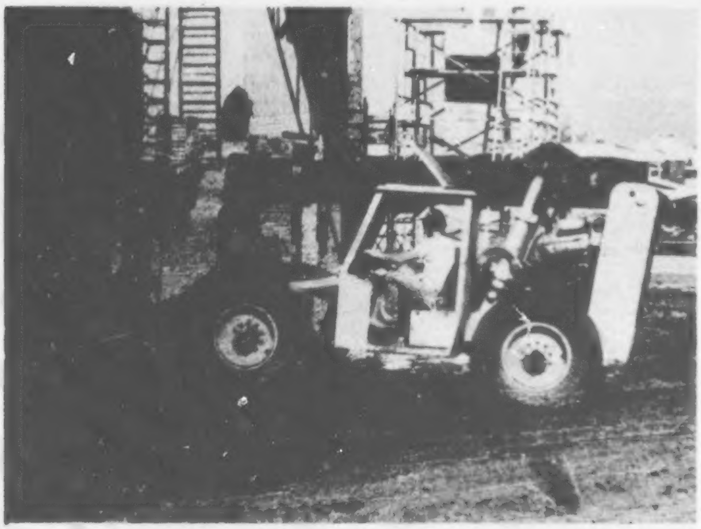
I. Equipment and material

A. Fork lift (Figure 12)

B. Brick

C. Mortar and rolling tub

FIGURE 12



II. Procedure

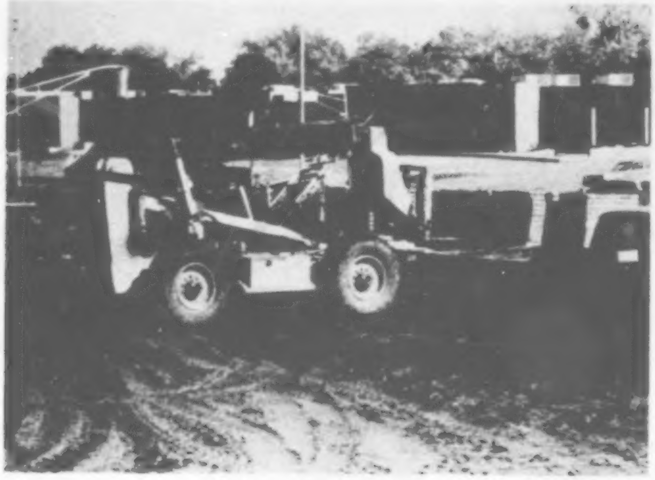
A. Mount fork lift and start engine

B. Raise fork to clear obstacles

JOB SHEET #4

C. Proceed to brick stockpile (Figure 13)

FIGURE 13



D. Approach stockpile and at the same time raise fork so that it is close to correct height to pick up cube of brick

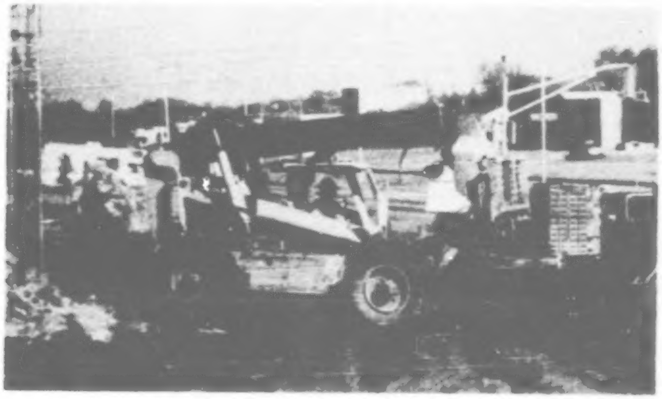
E. Move forward slowly, manipulating controls to adjust fork to enter slot in brick

F. Raise fork slightly and move in reverse at the same time

G. Tilt boom back slightly when cube is clear of other bricks and raise fork

H. Continue reverse movement until load is clear of stockpile and turn can be made (Figure 14)

FIGURE 14



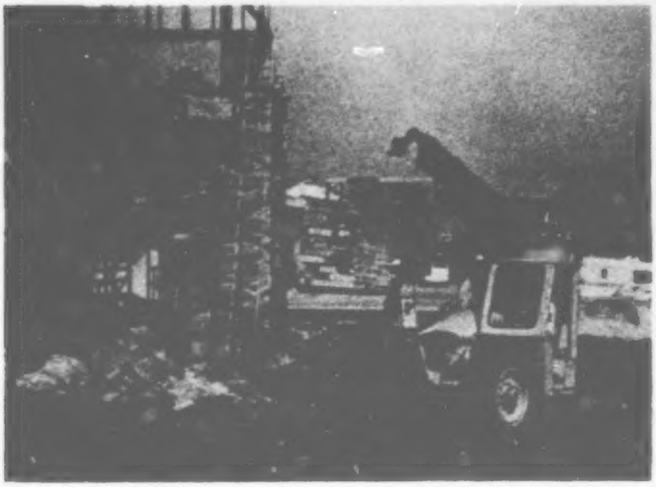
JOB SHEET #4

I. Lower load, keeping it high enough to clear obstacles

J. Proceed to scaffold (Figure 15)

(NOTE: Be cautious when traveling cver rough ground.)

FIGURE 15



K. Approach area carefully, and at the same time start raising load

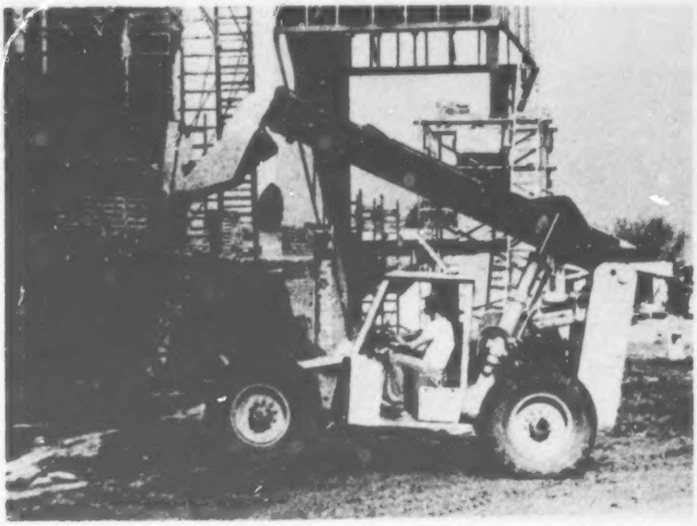
(CAUTION: Load should be raised cautiously and balance should be maintained to keep from tilting fork lift.)

L. Continue raising load until correct height is reached

JOB SHEET #4

M. Move forward and slowly lower load to scaffold; at the same time tilt boom forward to a level position (Figure 16)

FIGURE 16



N. Manipulate controls to adjust fork so that it is clear of brick

O. Move fork lift backward, away from scaffold

P. Continue these procedures until there are enough bricks on the scaffold

Q. Proceed to mixer location and pick up tub of mortar

R. Raise fork and tub enough to clear obstacles and move in reverse at the same time

S. Tilt boom back slightly

T. Continue reverse movement until turn can be made

JOB SHEET #4

U. Proceed to scaffold (Figure 17)

FIGURE 17

V. Approach scaffold cautiously and at the same time, raise load

W. Continue raising until correct height is reached

X. Move forward and slowly lower load to scaffold; at the same time, tilt boom forward to a level position (Figure 18)

FIGURE 18

JOB SHEET #4

Y. Manipulate controls to adjust fork so that it is clear of tub

Z. Move fork lift backward, away from scaffold (Figure 19)

FIGURE 19

AA. Continue these procedures until job is completed

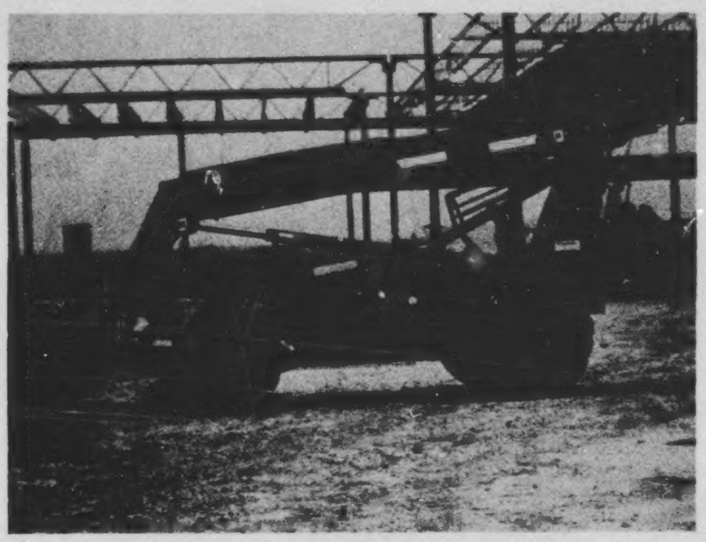
FORK LIFTS
UNIT VI

JOB SHEET #5--USE A FORK LIFT TO SET STEEL

I. Equipment and materials

- A. Fork lift (Figure 20)
- B. Bar joist

FIGURE 20



II. Procedure

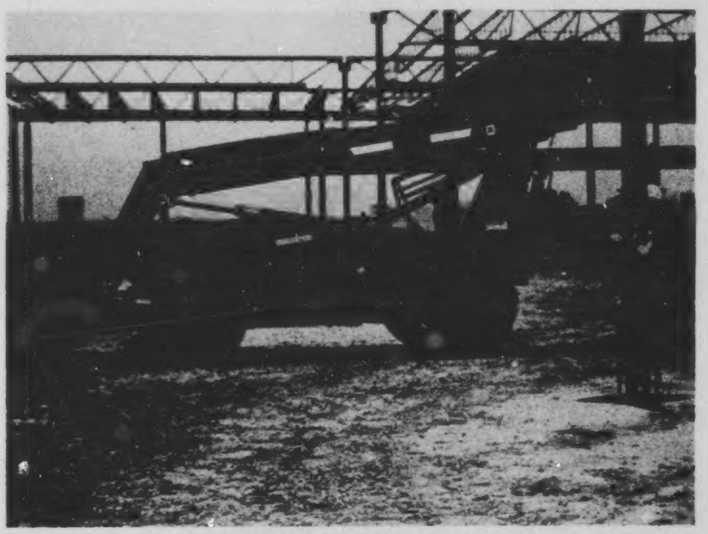
- A. Mount fork lift and start engine
- B. Raise fork to clear obstacles
- C. Proceed to joist location
- D. Move forward slowly to the approximate center of bar joist

  (NOTE: Ground crew will move two bar joists away from others and stand them up to make it convenient to pick them up.)
- E. Continue moving forward until forks are under top rail of bar joist

JOB SHEET #5

F. Raise forks until contact is made with the top rail (Figure 21)

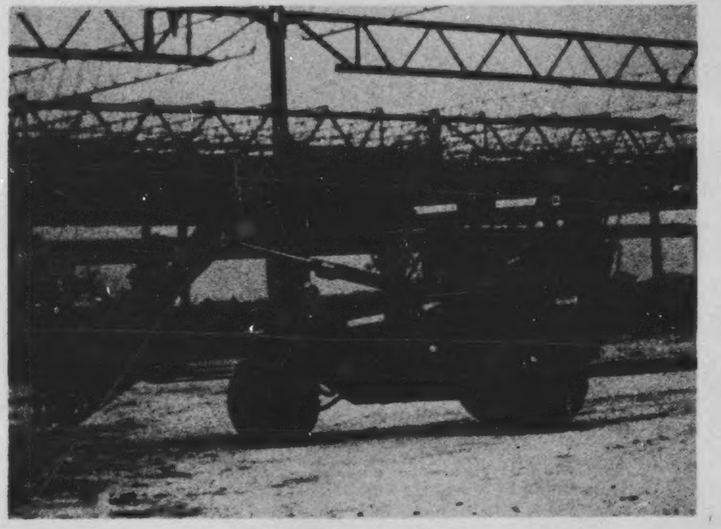
FIGURE 21



G. Continue, raising cautiously until you are sure joists are well-balanced

H. Tilt boom back slightly and move in reverse at the same time (Figure 22)

FIGURE 22



JOB SHEET #5

I. Continue reverse movement and manipulate controls to move fork lift so that the bar joist ends will clear columns

J. Move to location where joists are to be set

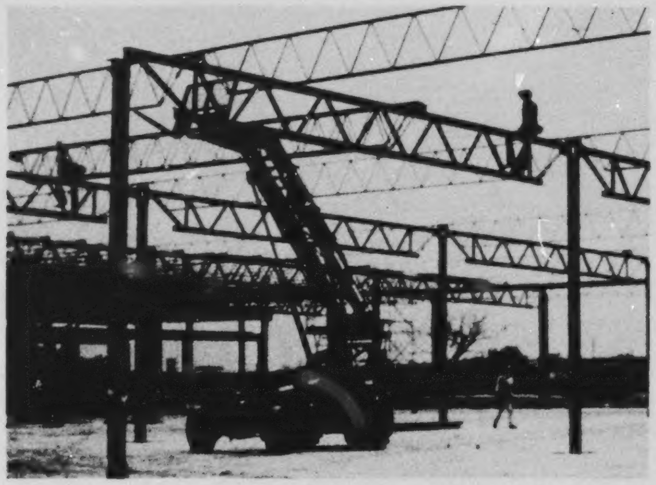
K. Raise boom until bar joists are near the beams

L. Manipulate controls to move fork lift so that bar joist will clear the beams

M. Set joist on top of beams at their approximate location (Figure 23)

(NOTE: Steel workers will maneuver bar joists to their exact locations and attach them to the beams.)

FIGURE 23



N. Lower fork enough to clear beams and move backward away from them

O. Lower forks and move back to joist location

P. Continue these procedures until all bar joists are set

FORK LIFTS
UNIT VI

TEST

NAME____________________________________ SCORE ______________________

1. List uses of rough terrain fork lifts.

   a. ____

   b. ____

   c. ____

2. Match terms associated with fork lifts to their correct definitions. Write the correct numbers in the blanks.

   ______a. Rough ground surface

   ______b. A tray or platform used for stacking material

   ______c. Tank or basin used primarily for storage or collection of a liquid

   ______d. Any material made up mostly of hydrocarbons, or mixtures of them, such as propane, propylene, butane (normal butane or isobutane), and butylenes

   ______e. A graduated rod for indicating amount of oil or fluid in a system

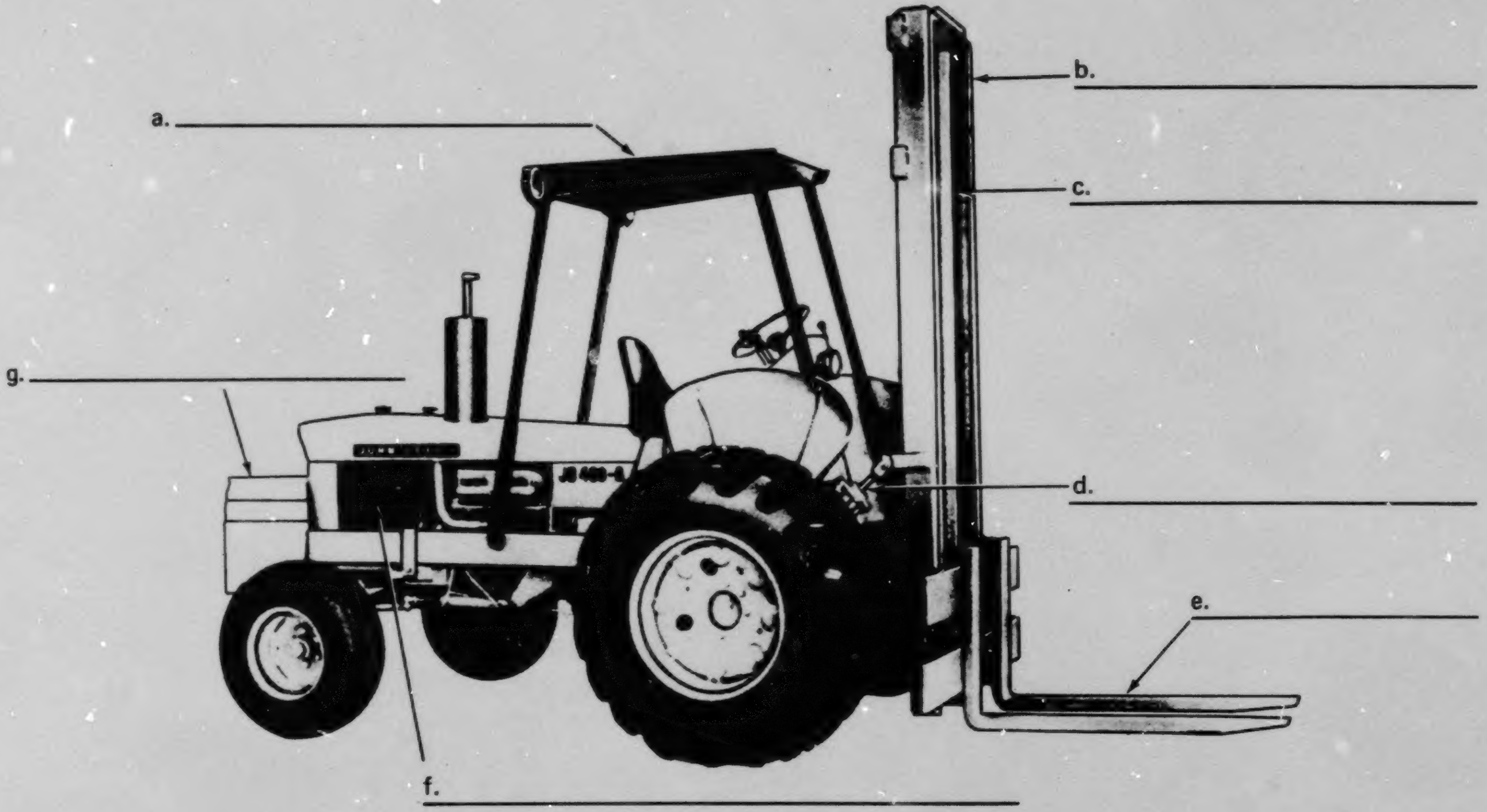
   ______f. Materials placed in a central area to be distributed later

   ______g. Stack of ninety blocks arranged four feet wide, four feet deep, and five blocks high

   1. Reservoir
   2. Rough terrain
   3. LP gas (liquefied petroleum gas)
   4. Dipstick
   5. Pallet
   6. Cube
   7. Stockpile

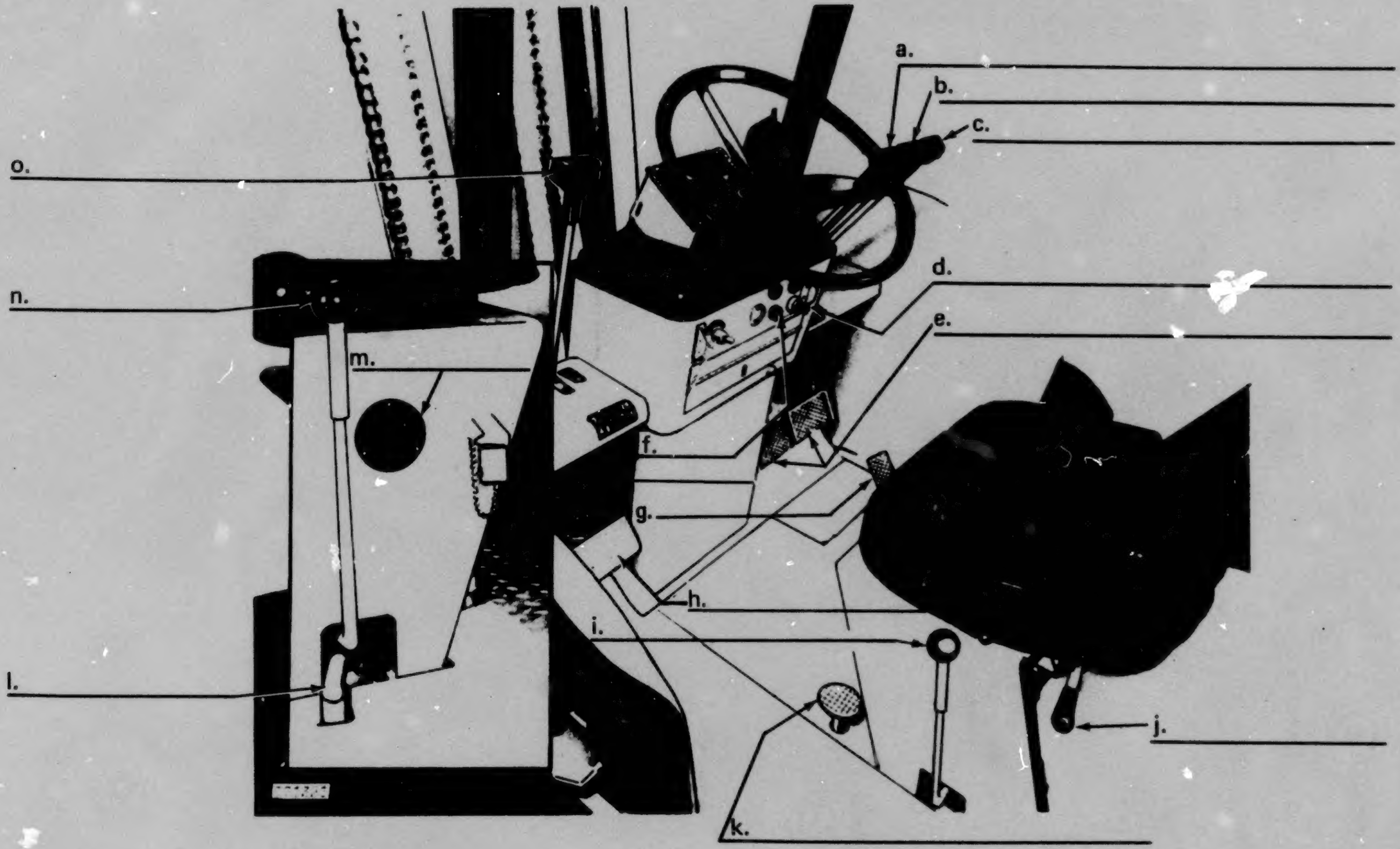
TEST

3. Label basic components of a fork lift. Write the correct names in the blanks.



TEST

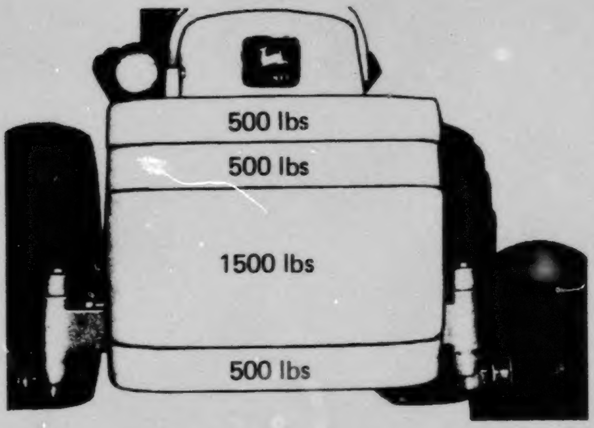
4. Label controls on a fork lift. Write the correct names in the blanks.

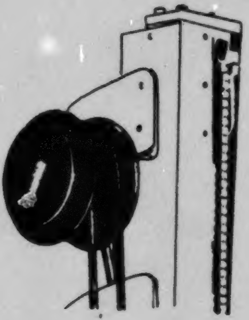

a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.
m.
n.
o.

TEST

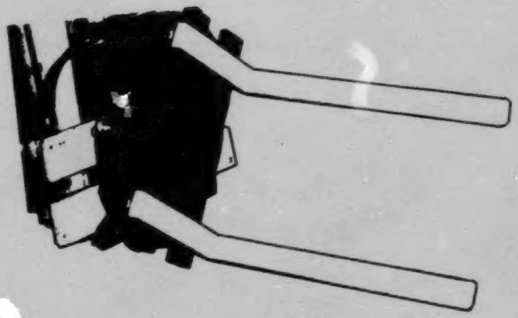
5. Identify accessories and/or attachments used on fork lifts. Write the correct names in the blanks provided.

Counterweights
Concrete block tines
Hose reel
Mortar hopper
Rotator


500 lbs
500 lbs
1500 lbs
500 lbs

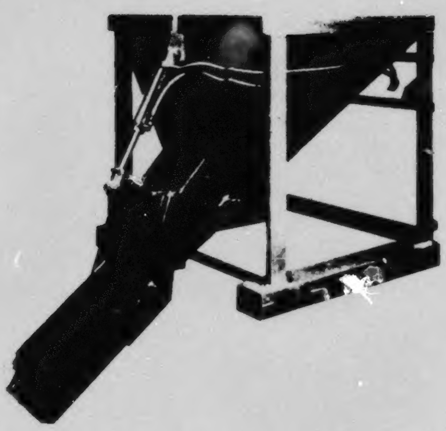


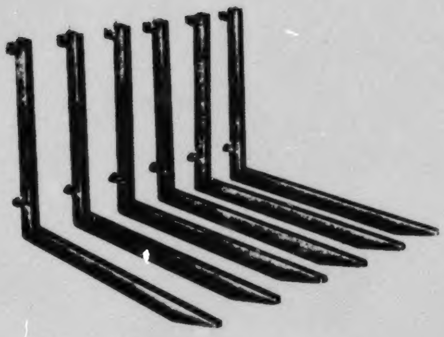
a. ______________________ b. ______________________



c. ______________________

TEST





d. ____________________ e. ____________________

6. State eight safety rules pertaining to fork lifts.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

7. State six suggestions for effective fork lift operations.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

TEST

8. Select from the following list items to check when servicing a fork lift. Write an "X" in the blank before each correct answer.

   _____a. Air cleaner filter

   _____b. All safety devices

   _____c. Exhaust system

   _____d. Rear wheel hubcaps

   _____e. Drive belts

   _____f. Radiator cap

   _____g. Tappet clearance

   _____h. Brake master cylinder fluid level

   _____i. Transmission fluid level

   _____j. Starter wicks

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Perform service on a fork lift.

   b. Start, warm up, and check gauges and performance of controls.

   c. Perform a basic unloading job.

   d. Stockpile material on a scaffold.

   e. Use a fork lift to set steel.

FORK LIFTS
UNIT VI

ANSWERS TO TEST

1. a. Load and unload materials
   b. Transport materials on job site
   c. Hoist materials

2. a. 2
   b. 5
   c. 1
   d. 3
   e. 4
   f. 7
   g. 6

3. a. R.O.P.S.
   b. Mast
   c. Carriage chains
   d. Tilt cylinder
   e. Forks
   f. Engine compartment
   g. Counterweights

4. a. Lift lever
   b. Tilt lever
   c. Side shift or equipment control lever
   d. Key switch
   e. Brake pedals
   f. Horn button
   g. Foot throttle
   h. Clutch pedal
   i. Gear shift lever
   j. Hand throttle
   k. Differential lock pedal
   l. Clutch disconnect lever
   m. Hourmeter
   n. Range shift lever
   o. Reverse control lever

ANSWERS TO TEST

5. a. Counterweights
   b. Hose reel
   c. Rotator
   d. Mortar hopper
   e. Concrete block tines

6. Answer should include any eight of the following
   a. Wear protective clothing and safety devices required by job conditions
   b. Never leave machine running unattended
   c. Never mount or dismount while machine is moving
   d. Never permit riders on machine
   e. Use extreme caution on slopes and grades
   f. Be sure load does not block view
   g. Do not drive close to edges of ditches or excavations
   h. Keep load as close to ground as possible when traveling
   i. Use extreme caution around power lines
   j. Lower fork to the ground when parking
   k. Be sure all bystanders are clear before starting operations
   l. Know and respond to hand signals given by signal person
   m. Be sure all safety devices are functioning properly

7. Answer should include any six of the following
   a. Set up work cycle so as to be as short as possible
   b. Keep transport distance as short as possible
   c. When transporting load, keep it just high enough to clear obstacles
   d. Keep machine clean
   e. Service machine regularly

ANSWERS TO TEST

f. Travel slowly and cautiously on rough ground

g. Operate engine at full throttle for maximum lift

h. Operate engine slower to place load smoothly

i. Adjust forks for each particular job

j. When stacking or unloading pallets, raise the top pallets slightly to keep them from catching on lower ones

8. a, b, c, e, f, h, i

9. Performance skills evaluated to the satisfaction of the instructor

HOISTS
UNIT VII

UNIT OBJECTIVE

After completing this unit, the student should be able to transfer rope from reel to drum and perform service on a hoist. This knowledge will be shown by completing the assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of hoists.
2. Match terms associated with hoists to their correct definitions.
3. Label basic components and controls on a double drum hoist.
4. List types of hoists.
5. Distinguish among standard hand signals used with hoisting.
6. Distinguish proper methods of transferring rope from reel to hoist drum.
7. State factors that determine rope anchorage point on a drum.
8. State safety precautions related to hoists.
9. State suggestions for effective hoist operations.
10. Select from a list items to check when performing service on a hoist (water-cooled gasoline engine.)
11. Determine rope anchorage point on a drum.
12. Demonstrate the ability to
    a. Perform a daily inspection on a hoist assembly (gasoline engine).
    b. Service a hoist.

HOISTS
UNIT VII

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Provide students with objective sheet.

  B. Provide students with information, assignment, and job sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information and assignment sheets.

  E. Demonstrate and discuss procedures outlined in job sheets.

  F. Provide operator's guides and service guides for particular equipment being used.

  G. Provide other jobs if job sheets are not practical.

  H. Stress to students that manipulation of controls and operating procedures may differ with different models and manufacturers.

  I. Stress to students the importance of safety devices and safety practices when operating equipment.

  J. Obtain and use material for reference, motivation, and complete study of the equipment.

  K. Give test.

II. Instructional materials

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Assignment sheets

    1. Assignment Sheet #1--Distinguish Among Hand Signals Used in Hoisting Operations

    2. Assignment Sheet #2--Determine Rope Anchorage Point on a Drum

  E. Answers to assignment sheets

SUGGESTED ACTIVITIES

F. Job sheets

  1. Job Sheet #1--Perform a Daily Inspection on a Hoist Assembly (Gasoline Engine)

  2. Job Sheet #2--Service a Hoist

G. Test

H. Answers to test

III. Unit references

A. *Crane Safety Training Manual*. The American Society of Mechanical Engineers. Orlando, Florida: Crane Inspection and Certification Bureau, n.d.

B. Dickie, D.E. *Rigging Manual*. Toronto: Construction Safety Association of Ontario, 1975.

HOISTS
UNIT VII

INFORMATION SHEET

I. Uses of hoists (Figure 1)

   A. Supply lifting force for personnel and material-handling elevators

   B. Supply lifting force for cranes

   C. Supply lifting force for derricks

   D. Supply lifting force for personnel lifts

   E. Supply lifting force for moving walks

   F. Supply lifting force for slip forms

   G. Supply lifting force for jacks

   H. Supply force for cableways and tramways

FIGURE 1

Courtesy of American Hoist and Derrick Company.

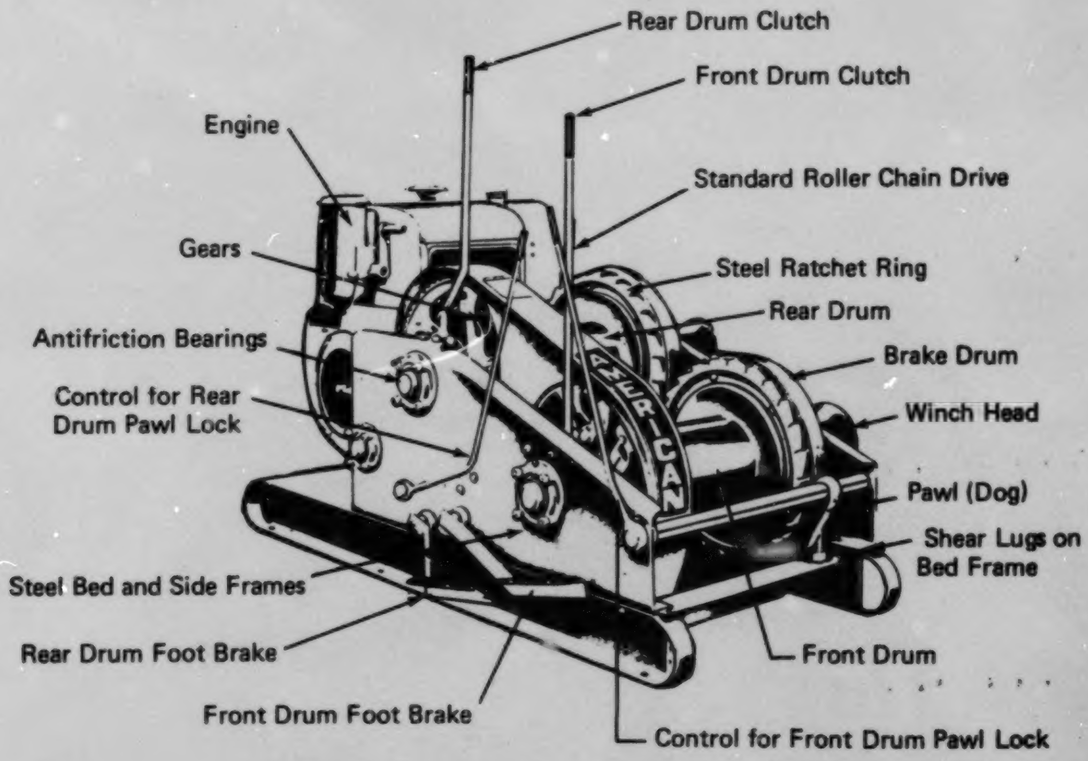
INFORMATION SHEET

II. Terms and definitions

- A. Hoist--Mechanism that exerts force for lifting, lowering, and pulling
- B. Reel--Revolving device on which cable is wound
- C. Pawl (dog)--Device used for positively keeping machinery from rotating
- D. Drum--Cylinder around which rope is wound when raising or lowering a load
- E. Lay of rope--Direction, length, or angle of twist of strands in a rope or cable
- F. Ratchet--Toothed member shaped to engage with the pawl

III. Basic components and controls on a double drum hoist (Figure 2)

FIGURE 2


Rear Drum Clutch
Front Drum Clutch
Engine
Standard Roller Chain Drive
Gears
Steel Ratchet Ring
Rear Drum
Antifriction Bearings
Brake Drum
Control for Rear Drum Pawl Lock
Winch Head
AMERICAN
Pawl (Dog)
Shear Lugs on Bed Frame
Steel Bed and Side Frames
Rear Drum Foot Brake
Front Drum
Front Drum Foot Brake
Control for Front Drum Pawl Lock

Used with permission of American Hoist and Derrick Company.

INFORMATION SHEET

IV. Types of hoists

(NOTE: A hoist may be equipped with one or more drums.)

A. Cable hoist

B. Chain hoist

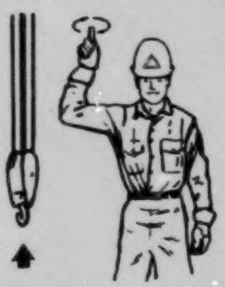
C. Rope hoist

(NOTE: Hoists may be powered by air-cooled gasoline engines, water-cooled gasoline engines, diesel engines, hydraulic power, air power, steam power, or electric power.)

V. Standard hand signals used with hoisting (Figures 3-8; Assignment Sheet #1)

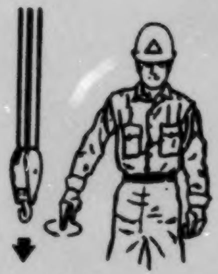
A. **Hoist**--Forearm vertical, forefinger pointing up; move hand in small horizontal circle

FIGURE 3



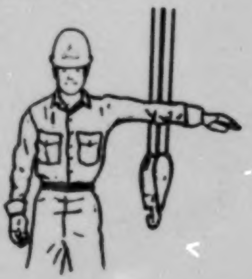
B. **Lower**--Arm extended downward, forefinger pointing down; move hand in small horizontal circle

FIGURE 4



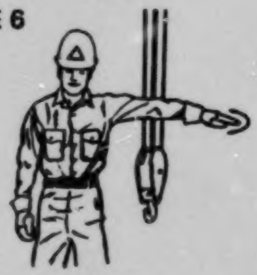
C. **Stop**--Arm extended, palm down; hold position rigidly

FIGURE 5



D. **Emergency stop**--Arm extended, palm down; move hand rapidly right and left

FIGURE 6

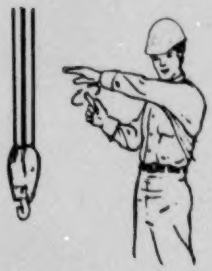


INFORMATION SHEET

E. **Move slowly**--One hand placed motionless in front of hand giving the motion signal

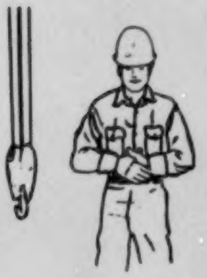
EXAMPLE: Hoist slowly.

FIGURE 7



F. **Dog everything**--Clasp hands in front of body

FIGURE 8



VI. Proper methods of transferring rope from reel to hoist drum (Figures 9 and 10)--Be sure rope is taken from top of the full reel and wound over top of empty drum (overwound) or if necessary, from bottom of the reel to the underside of the drum (underwound)

(NOTE: Reverse bends which tend to make rope harder to handle at a later date, are avoided. Mount the reel with the shaft parallel to the drum, and keep it under tension to avoid slack. Always reel from top to top or bottom to bottom.)

FIGURE 9

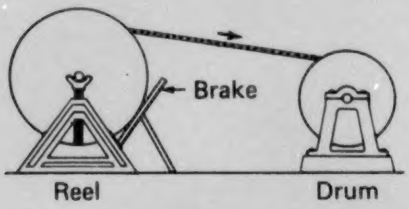


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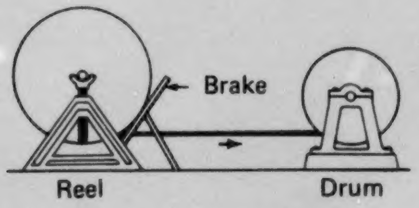
FIGURE 10



Used with the permission of the Construction Safety Association of Ontario.

INFORMATION SHEET

VII. Factors that determine rope anchorage point on a drum (Figures 11 and 12; Assignment Sheet #2)

A. Determine if rope is to be right lay rope or left lay rope

B. Determine if rope is to be overwound or underwound

EXAMPLES:

FIGURE 11

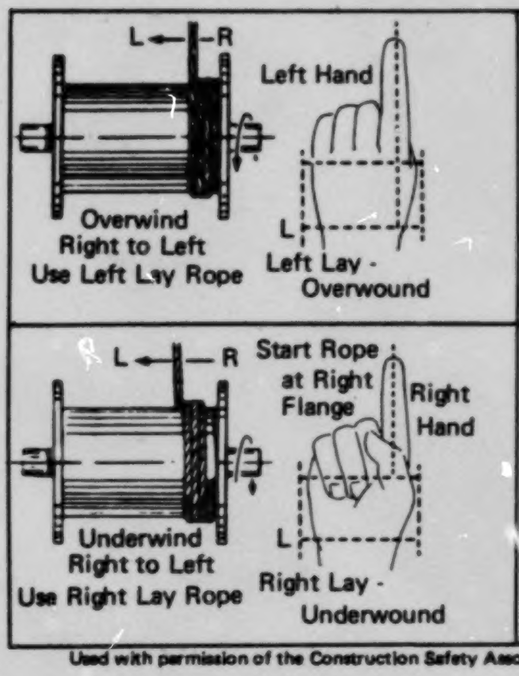
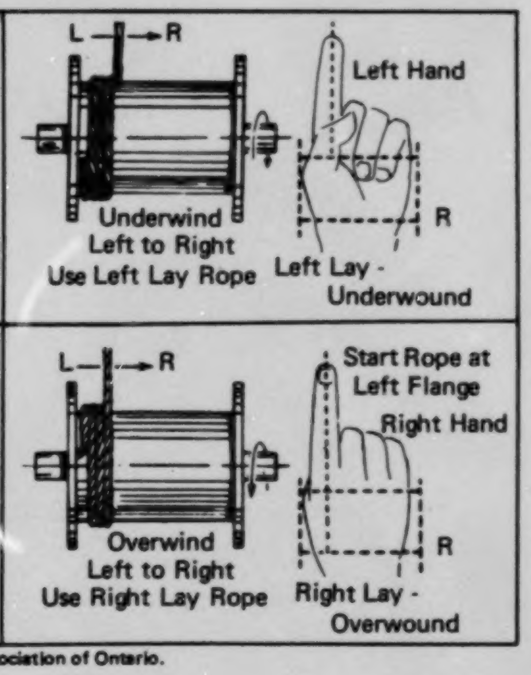

L
R
Left Hand
Overwind
Right to Left
Use Left Lay Rope
L
Left Lay -
Overwound
L
R
Start Rope
at Right
Flange
Right
Hand
Underwind
Right to Left
Use Right Lay Rope
L
Right Lay -
Underwound

FIGURE 12


L
R
Left Hand
Underwind
Left to Right
Use Left Lay Rope
R
Left Lay -
Underwound
L
R
Start Rope at
Left Flange
Right Hand
Overwind
Left to Right
Use Right Lay Rope
R
Right Lay -
Overwound

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VIII. Safety precautions related to hoists

A. Know hoist's maximum operating capacity

B. Never leave machine running unattended

C. Know and respond to hand signals given by signal person

D. Be sure all safety devices are functioning properly

E. Keep a fire extinguisher near the machine

F. Operate controls smoothly

G. Be sure all safety guards are in their proper places

INFORMATION SHEET

IX. Suggestions for effective hoist operations

A. Keep engine in good running order

B. Service equipment regularly

C. Keep equipment clean

D. Avoid jerky operations

E. Have enough rope for safe travel of hook block and/or attachment from highest to lowest point required with heavy loads

(NOTE: There must be at least three full wraps of rope on drum when hook is in lowest position.)

X. Items to check when performing service on a hoist (water-cooled gasoline engine)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Visual inspection for leaks and broken, worn, or missing parts

B. Engine oil level, filter, lines, and hoses

C. Air cleaner filter (element)

D. Engine coolant level, radiator cap, hoses, and radiator

(CAUTION: Do not remove radiator cap unless engine is cool; then, open slowly to release pressure.)

E. Fuel level, fuel filters, and sediment bowl (where applicable)

F. Battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Exhaust system

H. Drive belts for tension and wear

I. Wiring, insulation, and connections

J. All safety devices

K. Gauges and controls for proper functioning

L. Brake adjustment and condition

INFORMATION SHEET

M. Clutch for proper adjustment

N. Drums, ratchets, and dogs

O. Cables

P. Anchors

HOISTS
UNIT VII

ASSIGNMENT SHEET #1--DISTINGUISH AMONG HAND SIGNALS USED IN HOISTING OPERATIONS

NAME________________________________ SCORE______________

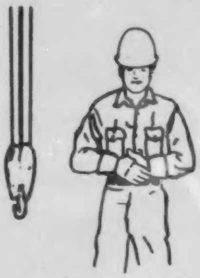
It is very important to know hand signals; by knowing them you may be able to help another worker get out of a bad situation and avoid a serious accident.

Distinguish among hand signals by writing an "X" in the blank before each correct answer.

A. ______1. Move slowly

______2. Emergency stop

______3. Dog everything

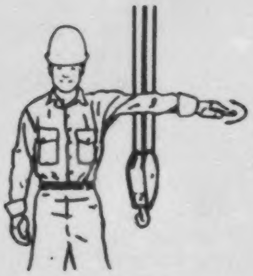


Clasp hands in front of body

B. ______1. Emergency stop

______2. Trolley travel

______3. Stop

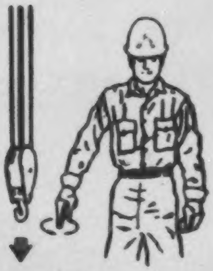


Arm extended, palm down; move hand rapidly right and left

C. ______1. Lower

______2. Single trolley

______3. Dog everything



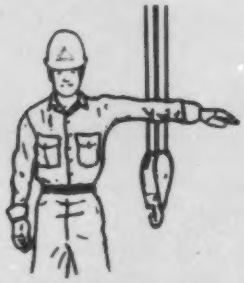
Arm extended downward, forefinger pointing down; move hand in small horizontal circle

ASSIGNMENT SHEET #1

D. _____1. Bridge travel

_____2. Stop

_____3. Trolley travel

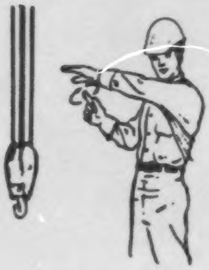


Arm extended, palm down; hold position rigidly

E. _____1. Move slowly

_____2. Dog everything

_____3. Hoist

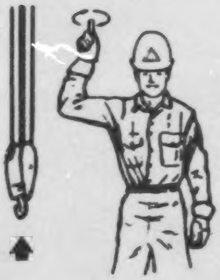


One hand placed motionless in front of hand giving the motion signal

F. _____1. Single trolley

_____2. Hoist

_____3. Move slowly



Forearm vertical, forefinger pointing up; move hand in small horizontal circle

HOISTS
UNIT VII

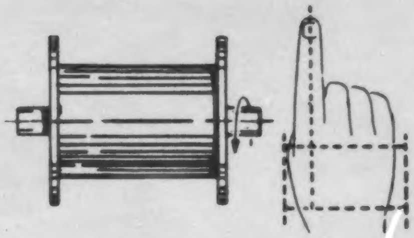
ASSIGNMENT SHEET #2--DETERMINE ROPE ANCHORAGE POINT ON A DRUM

NAME________________________________ SCORE______________

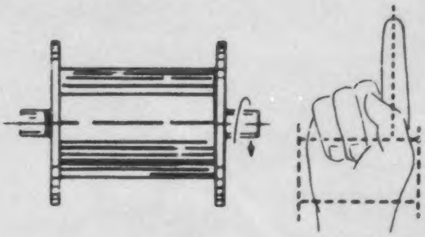
Determine from the illustrations if the drums are overwound or underwound and if the rope is left lay or right lay. Write "X" in the blank before each correct answer.

PART I

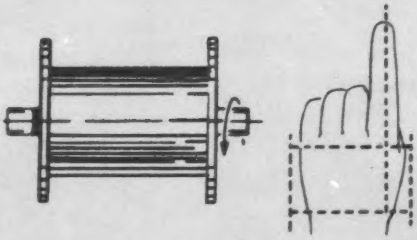
A. _____1. Overwound
_____2. Underwound
_____3. Left lay
_____4. Right lay



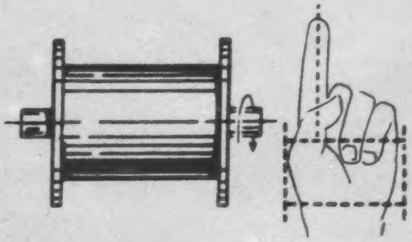
B. _____1. Overwound
_____2. Underwound
_____3. Left lay
_____4. Right lay



C. _____1. Overwound
_____2. Underwound
_____3. Left lay
_____4. Right lay



D. _____1. Overwound
_____2. Underwound
_____3. Left lay
_____4. Right lay

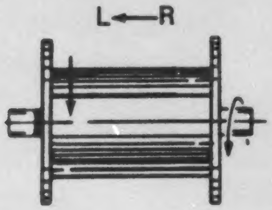


ASSIGNMENT SHEET #2

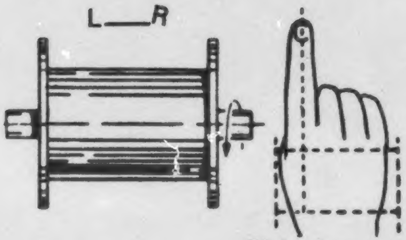
PART II

Indicate on the illustrations with an " ↓ " the proper anchorage point, and with another "→" indicate if the winding is right-to-left or left-to-right.

EXAMPLE:

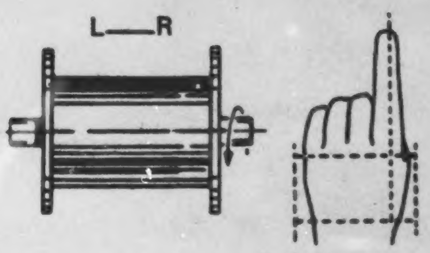


A.



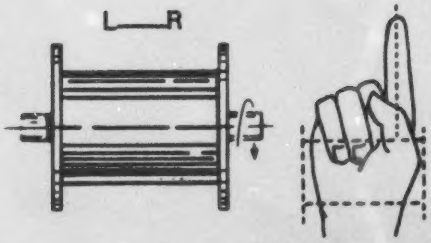
Right Lay

B.



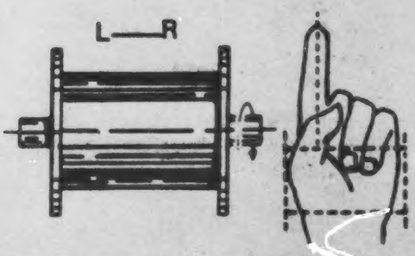
Left Lay

C.



Right Lay

D.



Left Lay

HOISTS
UNIT VII

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 3   F. 2

B. 1

C. 1

D. 2

E. 1

Assignment Sheet #2

PART I

A. 1, 4

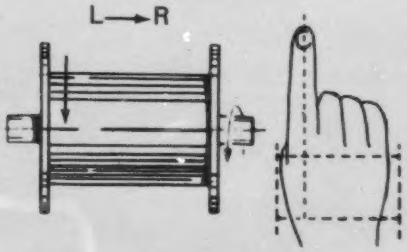
B. 2, 4

C. 1, 3

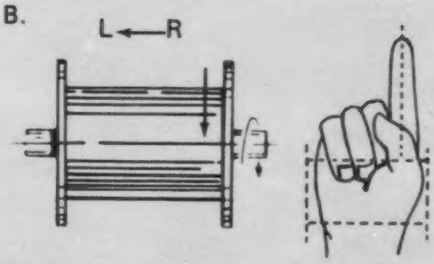
D. 2, 3

PART II

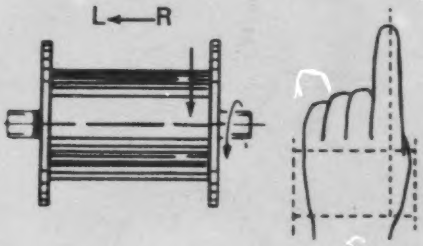
A.



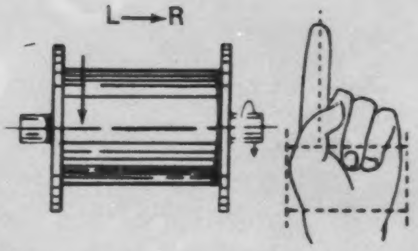
B.



C.



D.



HOISTS
UNIT VII

JOB SHEET #1--PERFORM A DAILY INSPECTION ON A HOIST ASSEMBLY (GASOLINE ENGINE)

I. Equipment and materials

- A. Hoist (gasoline engine)
- B. Tool kit
- C. Shop rags
- D. Engine oil
- E. Engine coolant
- F. Battery electrolyte
- G. Water
- H. Gasoline
- I. Cleaning solvent

II. Procedure

- A. Walk around equipment, inspecting for leaks and broken, worn, or missing parts

  (NOTE: Write down on paper any repairs that are needed.)

- B. Check engine oil level; fill if necessary
- C. Check engine coolant level; fill if necessary

  (CAUTION: Do not remove radiator cap unless engine is cool; then, open slowly to release pressure.)

- D. Check battery electrolyte level and battery cable connections; add water or electrolyte if necessary
- E. Check fuel level; fill if necessary
- F. Check air cleaner; clean or replace if necessary
- G. Check wires, insulation, and connections
- H. Check drive belts for condition and adjustment; adjust if necessary
- I. Check fuel pump sediment bowl (where applicable)

JOB SHEET #1

J. Check brake and clutch adjustment; adjust if necessary

K. Check exhaust system

L. Check safety devices

M. Check drums and cables

N. Inspect cleanliness of equipment

O. Check gauges for normal operation

P. Check controls for proper functioning

HOISTS
UNIT VII

JOB SHEET #2--SERVICE A HOIST

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

I. Equipment and materials

   A. Hoist (water-cooled gasoline engine)

   B. Service chart

   C. Tool kit and necessary replacement parts

   D. Lubricants

   E. Cleaning solvent

   F. Brushes

   G. Compressed air supply

   H. Engine coolant

   I. Fuel

   J. Grease gun and lubricant

   K. Shop rags

II. Procedure

   A. Visually inspect assembly for leaks and broken, worn, or missing parts

   B. Remove dipstick and check engine oil level; fill if necessary

   C. Check oil filters, lines, and hoses

   D. Check air cleaner filter (element); clean and service as necessary

   E. Check engine coolant level; fill if necessary

   (CAUTION: Do not remove radiator cap unless engine is cool; then, open slowly to release pressure.)

   F. Check radiator cap, hoses, and radiator

   G. Check fuel level; fill if necessary

   H. Check fuel filters and sediment bowl; clean and service as necessary

   I. Check battery electrolyte level; fill if necessary

JOB SHEET #2

J. Check battery cables and connections

(NOTE: Keep sparks and fire away from battery.)

K. Check exhaust system for defects

L. Check brake adjustment and condition; adjust if necessary

M. Check clutch for proper adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace as necessary

O. Check wiring, insulation, and connections; make repairs if necessary

P. Clean and lubricate all grease fittings

Q. Check all safety devices for proper functioning

R. Check drums, cables, ratchets, and dogs

S. Check gauges for normal operation

T. Check controls for proper functioning

HOISTS
UNIT VII

TEST

NAME____ SCORE__________________

1. List four uses of hoists.

a. ____

b. ____

c. ____

d. ____

2. Match terms associated with hoists to their correct definitions. Write the correct numbers in the blanks.

______a. Mechanism that exerts force for lifting, lowering, and pulling

______b. Revolving device on which cable is wound

______c. Device used for positively keeping machinery from rotating

______d. Cylinder around which rope is wound when raising or lowering a load

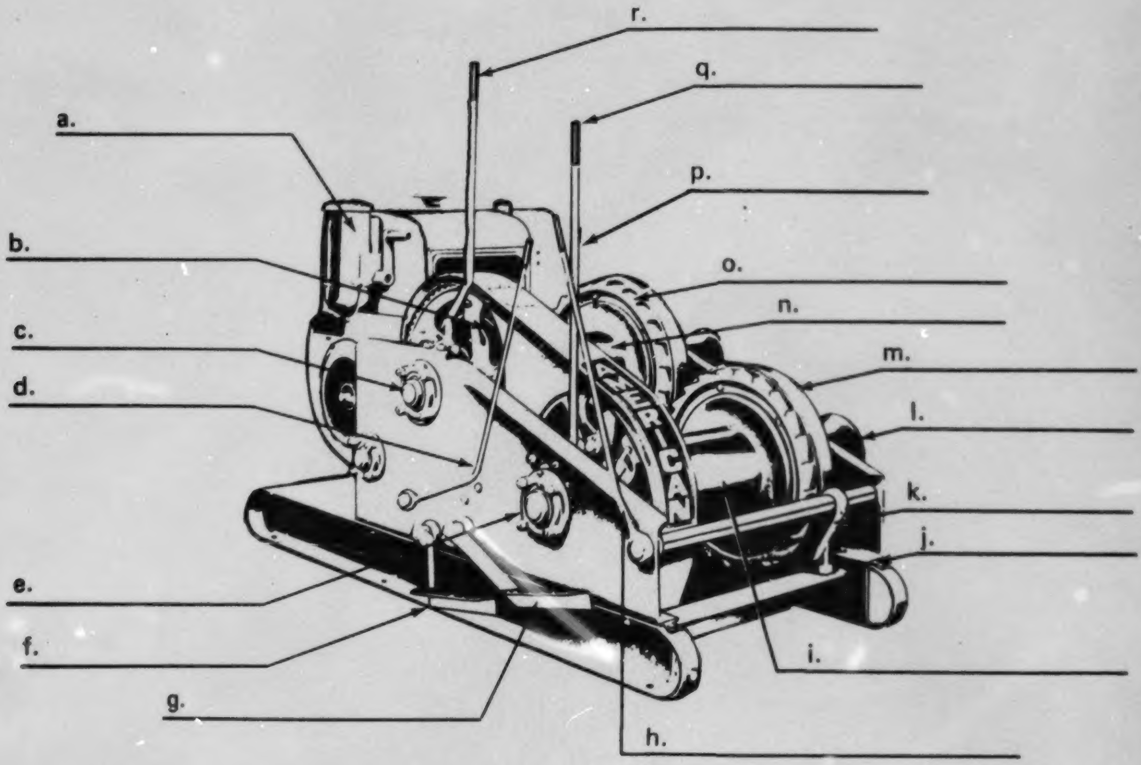
______e. Direction, length, or angle of twist of strands in a rope or cable

______f. Toothed member shaped to engage with the pawl

1. Lay of rope
2. Pawl (dog)
3. Ratchet
4. Hoist
5. Drum
6. Reel

TEST

3. Label basic components and controls on a double drum hoist. Write the correct names in the blanks.


r.
q.
a.
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o.
n.
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m.
d.
l.
k.
j.
e.
f.
i.
g.
h.
AMERICAN

4. List types of hoists.

a. ______________________________

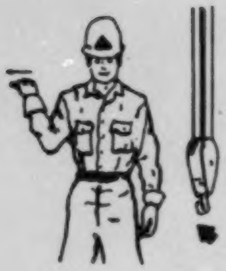
b. ______________________________

c. ______________________________

TEST

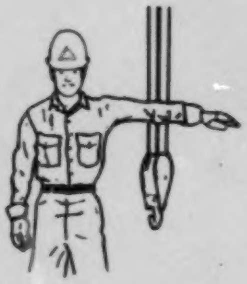
5. Distinguish among standard hand signals used with hoisting. Write an "X" in the blank under each correct illustration.

a. Stop



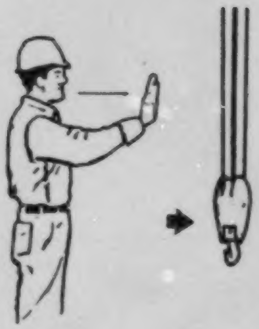
Palm up, fingers closed, thumb pointing in direction of motion; jerk hand horizontally

1) ______________



Arm extended, palm down; hold position rigidly

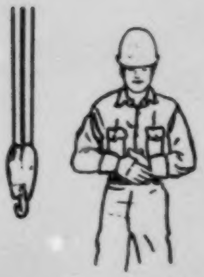
2) ______________



Arm extended forward, hand opened and slightly raised; make pushing motion in direction of travel

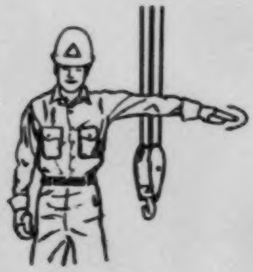
3) ______________

b. Emergency stop



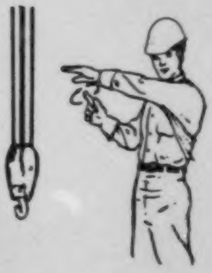
Clasp hands in front of body

1) ______________



Arm extended, palm down; move hand rapidly right and left

2) ______________

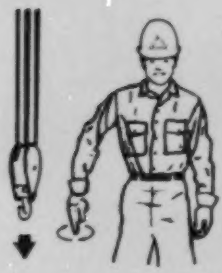


One hand placed motionless in front of hand giving the motion signal

3) ______________

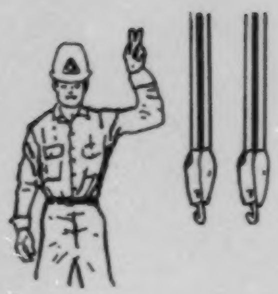
TEST

c. Lower



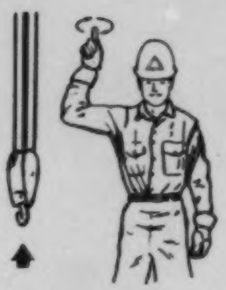
Arm extended downward, forefinger pointing down; move hand in small horizontal circle

1) ______________



Hold up one finger for block marked "1" and two fingers for block marked "2"; follow with regular signals

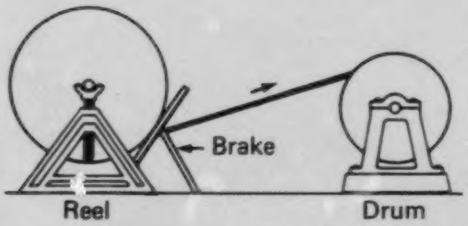
2) ______________



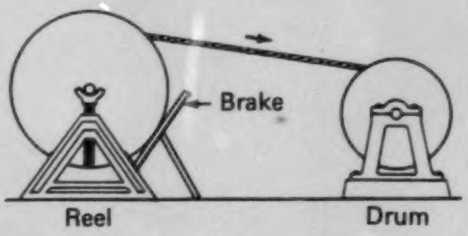
Forearm vertical, forefinger pointing up; move hand in small horizontal circle

3) ______________

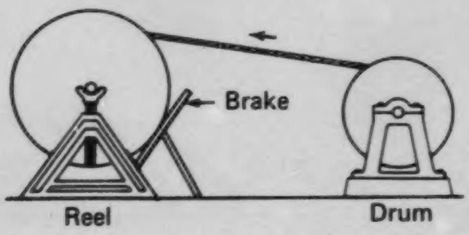
6. Distinguish proper methods of transferring rope from reel to hoist drum. Write an "X" in the blank under each correct illustration.


Brake
Reel
Drum

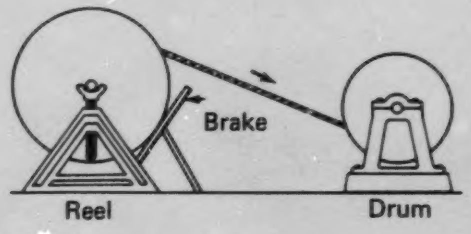
a. ______________________


Brake
Reel
Drum

b. ______________________

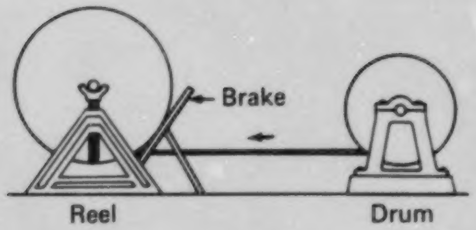

Brake
Reel
Drum

c. ______________________

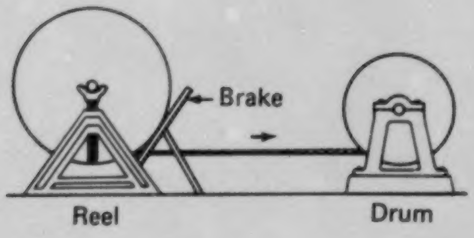

Brake
Reel
Drum

d. ______________________

TEST


Brake
Reel
Drum

e. ______________________


Brake
Reel
Drum

f. ______________________

7. State factors that determine rope anchorage point on a drum.

   a. ____

   b. ____

8. State five safety precautions related to hoists.

   a. ____

   ____

   b. ____

   ____

   c. ____

   ____

   d. ____

   ____

   e. ____

   ____

9. State three suggestions for effective hoist operations.

   a. ____

   ____

   b. ____

   ____

   c. ____

   ____

TEST

10. Select from the following list items to check when performing service on a hoist (water-cooled gasoline engine). Write an "X" in the blank before each correct answer.

______a. All safety devices

______b. Transmission fluid

______c. Battery electrolyte level, battery cables, and connectors

______d. Engine oil level, filter, lines, and hoses

______e. Engine coolant level, radiator cap, hoses, and radiator

______f. Hydraulic fluid

______g. Brake adjustment and condition

______h. rpm

______i. Cables

______j. Air cleaner filter (element)

______k. Anchors

______l. Rope capacity on drums

(NOTE: Test questions 11 and 12 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Determine rope anchorage point on a drum.

12. Demonstrate the ability to

    a. Perform a daily inspection on a hoist assembly (gasoline engine).

    b. Service a hoist.

HOISTS
UNIT VII

ANSWERS TO TEST

1. Answer should include any four of the following
    - a. Supply lifting force for personnel and material-handling elevators
    - b. Supply lifting force for cranes
    - c. Supply lifting force for derricks
    - d. Supply lifting force for personnel lifts
    - e. Supply lifting force for moving walks
    - f. Supply lifting force for slip forms
    - g. Supply lifting force for jacks
    - h. Supply force for cableways and tramways

2. a. 4
    - b. 6
    - c. 2
    - d. 5
    - e. 1
    - f. 3

3. a. Engine
    - b. Gears
    - c. Antifriction bearings
    - d. Control for rear drum pawl lock
    - e. Steel bed and side frames
    - f. Rear drum foot brake
    - g. Front drum foot brake
    - h. Control for front drum pawl lock
    - i. Front drum
    - j. Shear lugs on bed frame
    - k. Pawl (dog)
    - l. Winch head
    - m. Brake drum
    - n. Rear drum
    - o. Steel ratchet ring
    - p. Standard roller chain drive
    - q. Front drum clutch
    - r. Rear drum clutch

4. a. Cable hoist
    - b. Chain hoist
    - c. Rope hoist

ANSWERS TO TEST

5. a. 2
   b. 2
   c. 1

6. b, f

7. a. Determine if rope is to be right lay rope or left lay rope
   b. Determine if rope is to be overwound or underwound

8. Answer should include any five of the following
   a. Know hoist's maximum operating capacity
   b. Never leave machine running unattended
   c. Know and respond to hand signals given by signal person
   d. Be sure all safety devices are functioning properly
   e. Keep a fire extinguisher near the machine
   f. Operate controls smoothly
   g. Be sure all safety guards are in their proper places

9. Answer should include any three of the following
   a. Keep engine in good running order
   b. Service equipment regularly
   c. Keep equipment clean
   d. Avoid jerky operations
   e. Have enough rope for safe travel of hook block and/or attachment from highest to lowest point required with heavy loads

10. a, c, d, e, g, i, j, k

11. Evaluated to the satisfaction of the instructor

12. Performance skills evaluated to the satisfaction of the instructor

WATERING SYSTEMS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to fill water tanks and dispense water from a tanker according to specifications. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Describe uses of water wagons and trucks.
2. Match terms associated with watering systems to the correct definitions.
3. State safety precautions for filling, hauling, and dispensing water from a tank.
4. Distinguish between tools and equipment used to fill, haul, and dispense water.
5. Select from a list methods used to fill tanks.
6. Select from a list advantages of dispensing water under pressure (positive displacement) rather than gravity flow.
7. Discuss why and how haul roads, fill areas, and cut areas should be wet down.
8. Select from a list methods of controlling discharge rate when dispensing water.
9. Demonstrate the ability to
    a. Perform daily inspection.
    b. Fill and operate a water wagon.
    c. Fill and operate a tank truck.

WATERING SYSTEMS
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Provide students with objective sheet.

  B. Provide students with information and job sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information sheet.

  E. Demonstrate and discuss procedures outlined in job sheets.

  F. Provide alternate jobs if job sheets are not practical.

  G. Give test.

II. Instructional materials

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Job sheets

    1. Job Sheet #1–Perform Daily Inspection

    2. Job Sheet #2–Fill and Operate a Water Wagon

    3. Job Sheet #3--Fill and Operate a Tank Truck

  E. Test

  F. Answers to test

III. Unit reference--Armstrong, Coyn, H.E.O. instructor, and Mike Byrnes, H.E.O. coordinator, Central Oklahoma Area Vocational-Technical School, Drumright, Oklahoma.

WATERING SYSTEMS
UNIT I

INFORMATION SHEET

I. Uses of water wagons and trucks--For wetting down fill areas to bring moisture content up to specifications, to settle dust, and to provide a seal on a travel area (Figure 1)

FIGURE 1

II. Terms and definitions

A. Tanker--Water wagon used to wet down roadbeds and fill areas; in emergencies may be used to fight fires

B. Auxiliary pump--Truck-mounted pump used to fill tanker or to provide pressure for discharging water

C. Fire hydrant--Water supply for filling trucks

D. Hydrant wrench--Double-ended wrench used to remove cap from fire hydrant and for turning valve on fire hydrant

(NOTE: Never use a pipe wrench.)

E. Fill point--Point where truck is to be filled

F. Positive displacement--Water pumped under pressure

G. Gravity flow--Water flowing directly from truck without pressure

H. Boot--Flexible discharge tube used when filling tanker from an overhead supply

INFORMATION SHEET

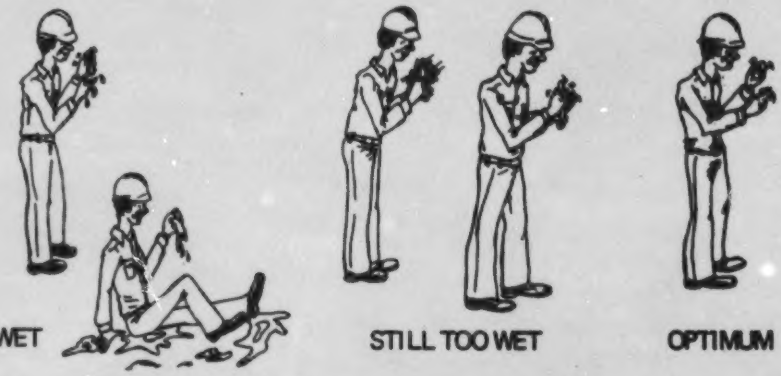
I. Construction meter--Portable water meter used on fire hydrants

J. Water supply-Point where source of water is used to fill tankers

K. Soil field test--Determining how moist or how dry soil is by checking a sample of dirt (Figure 2)

EXAMPLE:

FIGURE 2



L. Discharge valve--Shut-off valve on truck

M. Manhole-Opening on top of tank used when filling tank

III. Safety precautions for filling, hauling, and dispensing water from a tank

A. Inspect hose and/or standpipe for cracks, worn or frayed areas, and loose connections

B. Secure hose to tank to prevent it from whipping out

C. Use steps, ladders, and grab bars for climbing on, or off tank

(NOTE: Do not jump from machine.)

D. Do not overfill tank

E. Open valve on fire plug completely to prevent water from discharging back into the ground

F. Avoid sharp turns at high speeds because of high center of gravity of loaded tank

(NOTE: Sharp turns and high center of gravity could cause truck to turn over.)

G. Avoid rough terrain and potholes because weight of water in tank could break tank or gooseneck on trailer

INFORMATION SHEET

H. Avoid getting too close to edge of fill areas and overwetting areas to avoid getting stuck

I. Avoid getting electrical lines wet

J. Avoid getting people and other equipment wet when dispensing, especially with positive displacement units

IV. Tools and equipment used to fill, haul, and dispense water

A. Tools used for filling

1. Hammer
2. Hydrant wrench
3. Screwdriver
4. Pipe wrench

B. Equipment used for filling

1. Construction meter
2. Standpipe
3. Boot
4. Portable pump
5. Water can

C. Equipment used for hauling and dispensing

1. Tank truck

   (NOTE: A tank truck usually dispenses 2,000 gallons or less.)

2. Water wagon

   (NOTE: The water wagon is a large scraper-drawn tanker which holds a maximum of 15,000 gallons.)

3. Water cannon

   (NOTE: A water cannon is a device used to direct water flow to a precise location.)

4. Auxiliary pump for all positive displacement machines

5. Discharge spreader bar for gravity flow machines

INFORMATION SHEET

V. Methods used to fill tanks

   A. Standpipe

   B. Fire hydrant into manhole on tank

   C. Fire hydrant into filler pipe on tank

   D. Self-loading tank with auxiliary pump mounted on tank

   E. Portable gasoline pump in remote areas

   F. Boot with overhead supply

VI. Advantages of dispensing water under pressure (positive displacement) rather than gravity flow

   A. Dispense greater quantity of water

   B. Cover wider areas

   C. Direct water flow more accurately

   D. Spray banks, ditches, and areas that are inaccessible with machines

VII. Why and how haul roads, fill areas, and cut areas should be wet down

   A. Why

      1. Settle dust

      2. Seal roads

      3. Provide moisture to fill area for better compaction

   B. How

      1. Water trucks or tankers with auxiliary pumps

      2. Water trucks or tankers with gravity flow system

      3. Cannon system

      4. Hand-control sprinklers

VIII. Methods of controlling discharge rate when dispensing water

   A. Adjust discharge valve

   B. Vary pump speed

   C. Regulate vehicle speed

WATERING SYSTEMS
UNIT I

JOB SHEET #1--PERFORM DAILY INSPECTION

I. Equipment and materials

  A. Tractor or truck

  B. Water tank

  C. Note pad or checklist

  D. Rags (for wiping dipsticks and cleaning windshield)

II. Procedure

  A. Walk around equipment inspecting for broken, worn or missing parts, and leaks; also check condition of the tank, sprinkler system, and pumps

  (NOTE: Write down on paper any repairs that are needed.)

  B. Check engine oil level

  C. Check radiator coolant level

  D. Check battery electrolyte level and battery cable connections

  E. Check fuel level

  F. Check hydraulic fluid level

  G. Check air cleaner

  H. Check wires, insulation, and connections

  I. Check condition and adjustment of drive belts

  J. Check fuel pump sediment bowl (where applicable)

  K. Check transmission fluid level

  L. Check exhaust system

  M. Check safety devices

  N. Check condition of tires

  O. Check cleanliness of equipment

  P. Check windshield wipers and windshield (where applicable)

JOB SHEET #1

Q. Check major components and/or accessories

R. Check for normal operation of gauges

S. Check for proper functioning of controls

WATERING SYSTEMS
UNIT I

JOB SHEET #2–FILL AND OPERATE A WATER WAGON

(NOTE: The purpose of this job sheet is to show the operator how to fill a tanker at a fire hydrant and travel at a desired speed with rate of discharge set to provide the correct percentage of moisture for a particular job.)

I. Equipment and materials

   A. Tractor-drawn water wagon (tanker) (Figure 3)

   FIGURE 3

   B. Water supply

   C. Hoses and/or boots

   D. Construction meter (used on fire hydrant)

   E. Hydrant wrench

II. Procedure

   A. Move water wagon to fill point

   B. Use hydrant wrench to remove cap from fire hydrant

   C. Connect hose to fire hydrant

   D. Connect hose to tank

   E. Use hydrant wrench to open valve on fire hydrant

   (CAUTION: Always open fire hydrant valve to full "open" position.)

JOB SHEET #2

F. Turn off water supply when tank is full

G. Disconnect hose from water wagon

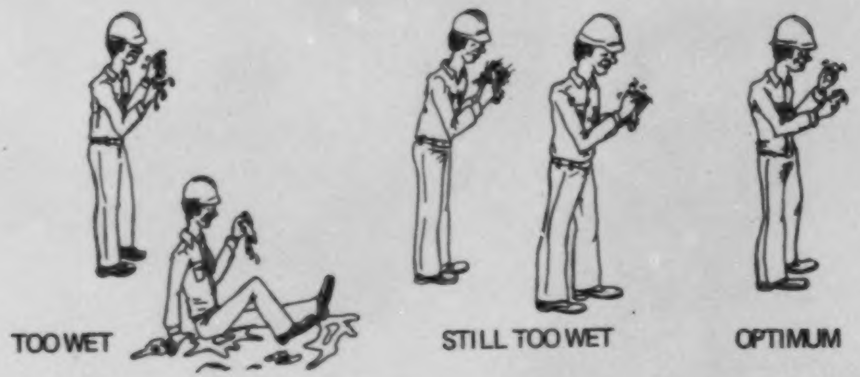
H. Climb safely onto machine and into operator's seat

I. Proceed to work area

J. Make a field test of soil to determine approximate quantity of water required (Figure 4)

EXAMPLE:

FIGURE 4



K. Position water wagon for first run; then engage pump or open discharge valve

L. Regulate travel speed to assure desired quantity of water to be dispensed

(NOTE: When discharging with pump pressure, the width of spray may cover a wide area; caution must be taken to avoid spraying on other machines and work crews.)

M. Maintain constant check on rate of travel, rate of discharge, and amount of water accumulation on the ground

N. Continue travel and discharge until tank is empty

O. Shut off pump or close valve as soon as tank is empty

P. Return to fill point

Q. Using same procedure as before, refill tank and return to work area

WATERING SYSTEMS
UNIT I

JOB SHEET #3–FILL AND OPERATE A TANK TRUCK

(NOTE: The purpose of this job sheet is to show the operator how to fill a tank truck from a pond and travel at a desired speed with the rate of discharge set to provide the correct percentage of moisture for a particular job.)

I. Equipment and materials

   A. Tank truck (Figure 5)

FIGURE 5

   B. Water supply

   C. Portable gasoline pump

   D. Hose

   E. Screwdriver

   F. Water can

   G. Gas can

   H. Oil

   I. Wire

II. Procedure

   A. Move truck to fill area

   B. Set pump on flat area near pond

JOB SHEET #3

C. Place suction hose into pond

(NOTE: Be sure suction hose has a screen on the end.)

D. Use screwdriver to connect hose to discharge connection on pump

(NOTE: Sometimes universal quick connectors are used.)

E. Open manhole and insert end of discharge hose into opening; use wire to tie down hose to keep water pressure from flipping hose out of opening

F. Check oil and gasoline in pump

G. Take plug out of primer opening and fill with water

H. Start pump

(NOTE: Observe filling process to avoid overflow.)

I. Turn off pump when tank is full

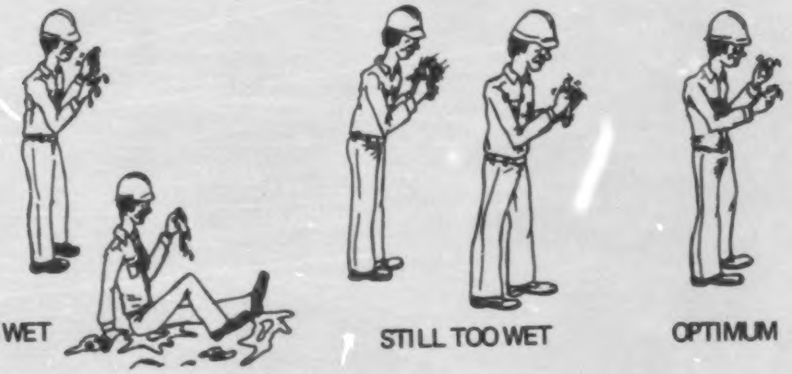
J. Remove hose from tank and close manhole

K. Climb safely into cab of truck and proceed to work area

L. Make field test of soil to determine approximate quantity of water required (Figure 6)

EXAMPLE:

FIGURE 6



TOO WET

STILL TOO WET

OPTIMUM

JOB SHEET #3

M. Position truck for first run and engage auxiliary pump

N. Regulate travel speed to assure desired quantity of water to be dispensed

(NOTE: Avoid disrupting traffic patterns of other equipment.)

(CAUTION: When discharging with pump pressure, the width of spray may cover a wide area; precaution must be taken to avoid spraying on other machines and work crews.)

O. Maintain constant check on rate of travel, rate of discharge, and amount of water accumulation on the ground

P. Continue travel and discharge until tank is empty

Q. Shut off pump as soon as tank is empty

R. Return to fill point

S. Using same procedure as before, refill tank and return to work area

WATERING SYSTEMS
UNIT I

TEST

NAME ______________________ SCORE ____________

1. Describe uses of water wagons and trucks.

____

____

____

2. Match terms associated with watering systems to the correct definitions. Write the correct numbers in the blanks.

______ a. Water wagon used to wet down roadbeds and fill areas; in emergencies may be used to fight fires

______ b. Water supply for filling trucks

______ c. Truck-mounted pump used to fill tanker or to provide pressure for discharging water

______ d. Double-ended wrench used to remove cap from fire hydrant and for turning valve on fire hydrant

______ e. Water pumped under pressure

______ f. Water flowing directly from truck without pressure

______ g. Flexible discharge tube used when filling tanker from an overhead supply

______ h. Portable water meter used on fire hydrants

______ i. Point where source of water is used to fill tankers

______ j. Point where truck is to be filled

______ k. Determining how moist or how dry soil is by checking a sample of dirt

______ l. Shut-off valve on truck

______ m. Opening on top of tank used when filling tank

1. Positive displacement
2. Hydrant wrench
3. Boot
4. Tanker
5. Water supply
6. Auxiliary pump
7. Soil field test
8. Fill point
9. Manhole
10. Construction meter
11. Fire hydrant
12. Gravity flow
13. Discharge valve

[illegible] COPY AVAILABLE

TEST

3. State seven safety precautions for filling, hauling, and dispensing water from a tank.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

f. ____

____

g. ____

____

4. Distinguish between tools and equipment used to fill, haul, and dispense water. Write a "T" in blanks before tools used for filling, an "EF" in blanks before equipment used for filling, and an "EHD" in blanks before equipment used for hauling and dispensing.

______a. Standpipe

______b. Boot

______c. Pipe wrench

______d. Water wagon

______e. Water can

______f. Discharge spreader bar for gravity flow machines

______g. Hammer

______h. Construction meter

______i. Water cannon

TEST

______j. Portable pump

______k. Hydrant wrench

______l. Screwdriver

______m. Auxiliary pump for all positive displacement machines

______n. Tank truck

5. Select from the following list methods used to fill tanks. Write an "X" in the blank before each correct method.

______a. Fire hydrant through portable pump

______b. Portable gasoline pump in remote areas

______c. Fire hydrant into filler pipe on tank

______d. Sprinkler system

______e. Boot with overhead supply

______f. Boot into filler pipe on tank

______g. Standpipe

6. Select from the following list advantages of dispensing water under pressure (positive displacement) rather than gravity flow. Write an "X" in the blank before each correct answer.

______a. Soak fill area

______b. Cover wider areas

______c. Spray trees and shrubbery

______d. Dispense greater quality of water

______e. Direct water flow more accurately

______f. Dispense greater quantity of water

7. Discuss why and how haul roads, fill areas, and cut areas should be wet down.

a. Why-- ____

____

____

____

TEST

b. How– ____

____

____

____

____

8. Select from the following list methods of controlling discharge rate when dispensing water. Write an "X" in the blank before each correct method.

_____a. Vary pump speed

_____b. Leave manhole open

_____c. Adjust overflow valve

_____d. Adjust discharge valve

_____e. Regulate vehicle speed

_____f. Change level of water in tank

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Perform daily inspection.

   b. Fill and operate a water wagon.

   c. Fill and operate a tank truck.

WATERING SYSTEMS
UNIT I

ANSWERS TO TEST

1. Description should include the following

   For wetting down fill areas to bring moisture content up to specifications, to settle dust, and to provide a seal on a travel area

2. a. 4
   b. 11
   c. 6
   d. 2
   e. 1
   f. 12
   g. 3
   h. 10
   i. 5
   j. 8
   k. 7
   l. 13
   m. 9

3. Answer should include any seven of the following

   a. Inspect hose and/or standpipe for cracks, worn or frayed areas, and loose connections

   b. Secure hose to tank to prevent it from whipping out

   c. Use steps, ladders, and grab bars for climbing on, or off of tank

   d. Do not overfill tank

   e. Open valve on fire plug completely to prevent water from discharging back into the ground

   f. Avoid sharp turns at high speeds because of high center of gravity of loaded tank

   g. Avoid rough terrain and potholes because weight of water in tank could break tank or gooseneck on trailer

   h. Avoid getting too close to edge of fill areas and overwetting areas to avoid getting stuck

   i. Avoid getting electrical lines wet

   j. Avoid getting people and other equipment wet when dispensing, especially with positive displacement units

ANSWERS TO TEST

4. a. EF
   b. EF
   c. T
   d. EHD
   e. EF
   f. EHD
   g. T
   h. EF
   i. EHD
   j. EF
   k. T
   l. T
   m. EHD
   n. EHD

5. b, c, e, g

6. b, e, f

7. Discussion should include the following
   a. Why
      1) Settle dust
      2) Seal roads
      3) Provide moisture to fill areas for better compaction
   b. How
      1) Water trucks or tankers with auxiliary pumps
      2) Water trucks or tankers with gravity flow system
      3) Cannon system
      4) Hand-control sprinklers

8. a, d, e

9. Performance skills evaluated to the satisfaction of the instructor

SCRAPERS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a scraper to perform basic, intermediate, and difficult jobs. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of scrapers.
2. Match terms associated with scrapers to their correct definitions.
3. Label types of scrapers.
4. Label parts of a standard wheel tractor scraper.
5. Label parts of an elevating wheel tractor scraper.
6. Label parts of a push-pull tractor scraper.
7. Identify controls on a typical tractor scraper.
8. State suggestions for effective scraper operations.
9. State safety precautions to observe while operating a scraper.
10. Select from a list items to check on a daily inspection.
11. Select from a list procedures for servicing a scraper.
12. List equipment and materials needed to perform service on a scraper.
13. Demonstrate the ability to
    a. Start, warm up, check gauges, and test controls for performance; make final visual check.
    b. Cut, load earth, move to fill area, and spread.
    c. Strip topsoil and stockpile.
    d. Operate scraper, using bulldozer as pusher.
    e. Finish grade a pad.
    f. Shut down scraper.

SCRAPERS
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Order films and other materials planned to supplement unit.

  B. Provide students with objective sheet.

  C. Provide students with information, assignment, and job sheets.

  D. Discuss unit and specific objectives.

  E. Discuss information and assignment sheets.

  F. Demonstrate and discuss procedures outlined in job sheets.

  G. Provide alternate jobs if job sheets are not practical.

  H. Stress to students that manipulation of controls and operating procedures may differ with certain models and different manufacturers.

  I. Provide operator's guide for the particular equipment being used.

  J. Give test.

II. Instructional materials

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Assignment Sheet #1--List Equipment and Materials Needed to Perform Service on a Scraper

  E. Answers to assignment sheet

  F. Job sheets

    1. Job Sheet #1--Start, Warm Up, Check Gauges, and Test Controls for Performance; Make Final Visual Check

    2. Job Sheet #2--Cut, Load Earth, Move to Fill Area, and Spread

    3. Job Sheet #3--Strip Topsoil and Stockpile

    4. Job Sheet #4--Operate Scraper, Using Bulldozer as Pusher

SUGGESTED ACTIVITIES

   5. Job Sheet #5--Finish Grade a Pad

   6. Job Sheet #6--Shut Down Scraper

G. Test

H. Answers to test

III. Unit references

A. Nichols, Herbert L., Jr. *Moving the Earth*, 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

B. *Operator's Guide for 627B and 613B Wheel Tractor-Scrapers*. Peoria, Illinois: Caterpillar Tractor Co., n.d.

SCRAPERS
UNIT II

INFORMATION SHEET

I. Uses of scrapers (Figure 1)

A. Earth moving (loading and hauling)

B. Spreading materials (depositing loads in thick layers and cutting off high spots)

FIGURE 1

Courtesy of Caterpillar Tractor Company.

II. Terms and definitions

A. Cycle time--Time required to load, haul, dump, spread, and return to loading position

B. Fixed time--Time given to loading, dumping, turning, accelerating, and decelerating

(NOTE: Fixed time does not include hauling or returning empty.)

C. Strip--Remove overburden or thin layers of material

D. Slope--Ground that forms a natural or artificial incline

E. Stockpile--Earth put into a pile and saved for future use

INFORMATION SHEET

F. Pay material (formation)--Deposit of soil valuable enough to stockpile for future use

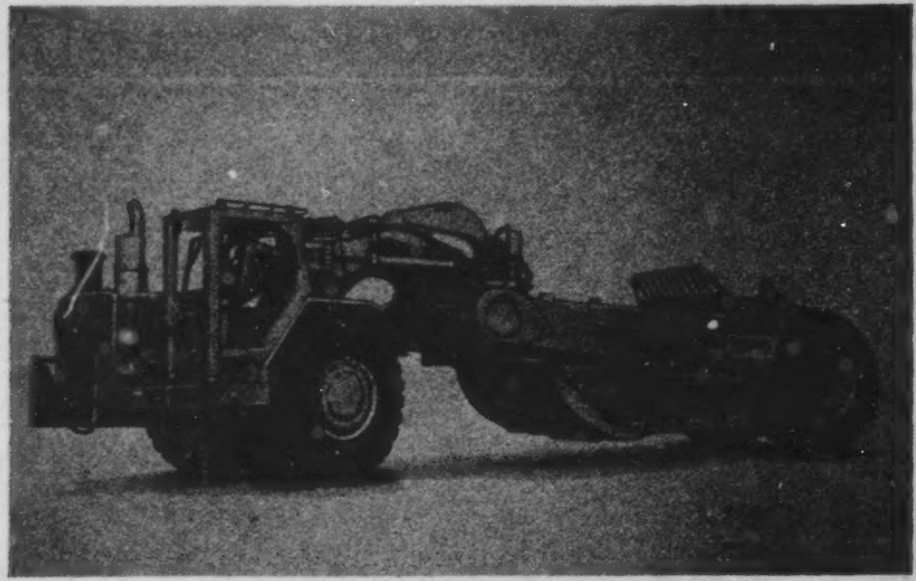
G. Grade checker--Person who checks grades and signals operator

H. ROPS--Rollover protective structure

III. Types of scrapers (Figures 2-7)

A. Standard wheel tractor scraper

FIGURE 2

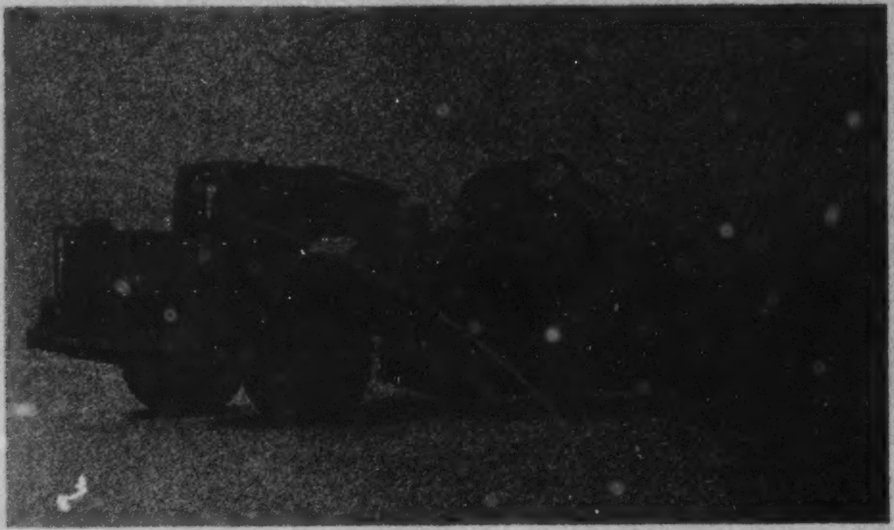


Courtesy of Caterpillar Tractor Company.

INFORMATION SHEET

B. Elevating wheel tractor scraper

FIGURE 3



Courtesy of Caterpillar Tractor Company.

C. Tandem-powered wheel tractor scraper

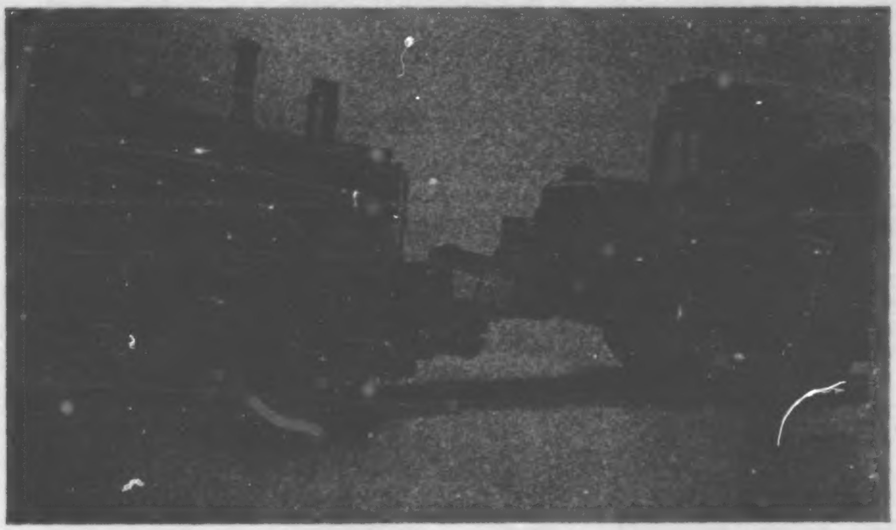
FIGURE 4

Courtesy of Caterpillar Tractor Company.

INFORMATION SHEET

D. Push-pull wheel tractor scraper

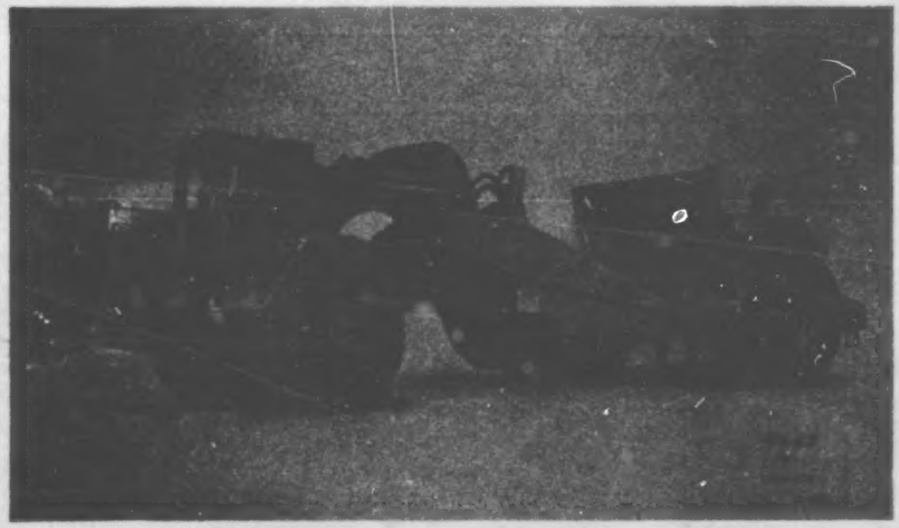
FIGURE 5



Courtesy of Caterpillar Tractor Company.

E. Elevating tandem-powered wheel tractor scraper

FIGURE 6



Courtesy of Caterpillar Tractor Company.

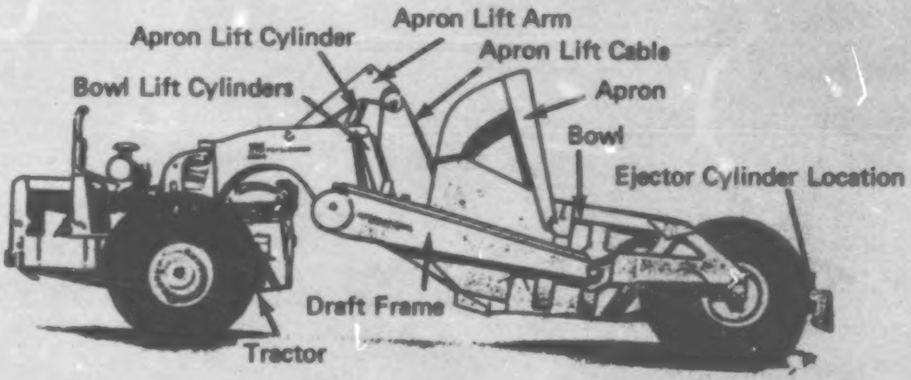
INFORMATION SHEET

F. Special type coal scraper

FIGURE 7

IV. Parts of a standard wheel tractor-scraper (Figure 8)

FIGURE 8

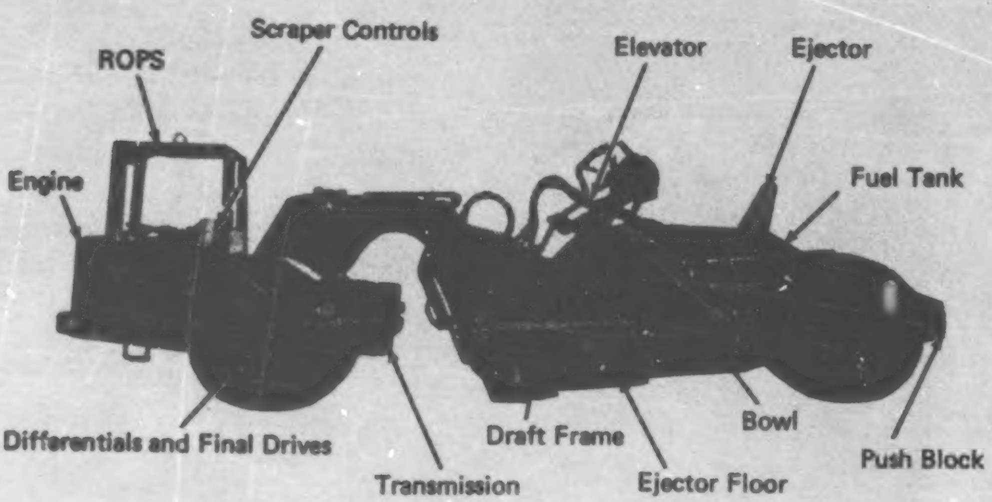

Apron Lift Arm
Apron Lift Cylinder
Apron Lift Cable
Bowl Lift Cylinders
Apron
Bowl
Ejector Cylinder Location
Draft Frame
Tractor

Used with permission of International Harvester Company.

INFORMATION SHEET

V. Parts of an elevating wheel tractor scraper (Figure 9)

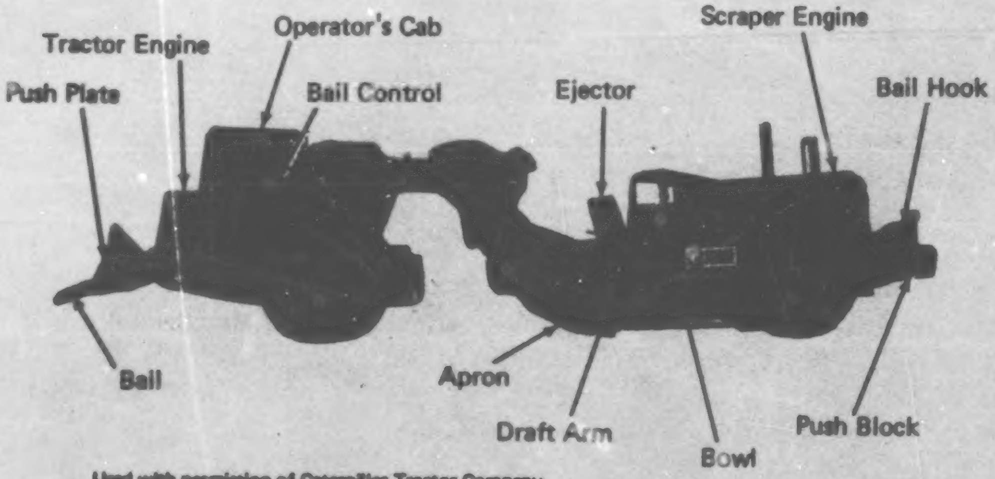
FIGURE 9


Scraper Controls
ROPS
Elevator
Ejector
Engine
Fuel Tank
Differentials and Final Drives
Draft Frame
Bowl
Push Block
Transmission
Ejector Floor

Used with permission of Caterpillar Tractor Company.

VI. Parts of a push-pull wheel tractor scraper (Figure 10)

FIGURE 10

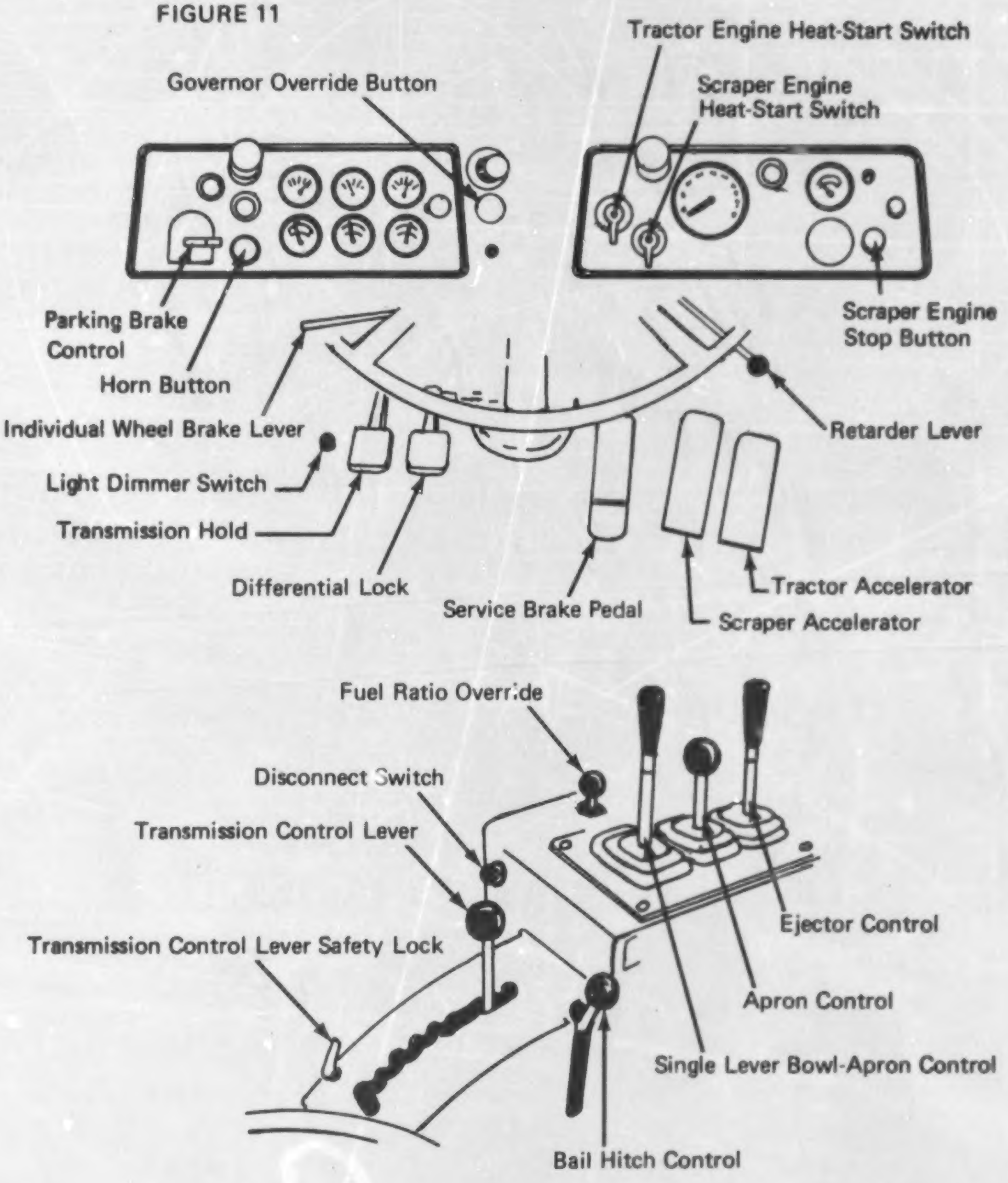

Operator's Cab
Scraper Engine
Tractor Engine
Push Plate
Bail Control
Ejector
Bail Hook
Bail
Apron
Draft Arm
Push Block
Bowl

Used with permission of Caterpillar Tractor Company.

INFORMATION SHEET

VII. Controls on a typical scraper (Figure 11)

FIGURE 11


Tractor Engine Heat-Start Switch
Governor Override Button
Scraper Engine Heat-Start Switch
Parking Brake Control
Scraper Engine Stop Button
Horn Button
Individual Wheel Brake Lever
Retarder Lever
Light Dimmer Switch
Transmission Hold
Differential Lock
Service Brake Pedal
Tractor Accelerator
Scraper Accelerator
Fuel Ratio Override
Disconnect Switch
Transmission Control Lever
Transmission Control Lever Safety Lock
Ejector Control
Apron Control
Single Lever Bowl-Apron Control
Bail Hitch Control

Used with permission of Caterpillar Tractor Company.

INFORMATION SHEET

VIII. Suggestions for effective scraper operations

- A. Do not work machine over capacity
- B. Dump and spread material at highest practical travel speed
- C. Up shift and travel at highest practical speed for return to cut
- D. Use extreme care when turning on a down grade
- E. Service equipment regularly to ensure efficient operation
- F. Keep equipment clean
- G. Set up work cycle so that it will be as short as possible
- H. Calculate and plan operations before starting

IX. Safety precautions to observe while operating a scraper

- A. Wear safety items required by job conditions
- B. Know and observe hand signals
- C. Be sure machine is equipped with clearance lights and flags
- D. Be sure all safety guards and covers are secured in place
- E. Check all safety devices before moving machine
- F. Do not jump onto or from moving equipment
- G. Do not allow anyone to ride on machine
- H. Know traffic pattern of job and obey signal person
- I. Stay clear of all danger areas (electrical, slide areas, and overhangs)
- J. Use extra caution when crossing side hills, ridges, ditches, and any other obstacles
- K. Do not back machine until you are sure personnel and obstructions are clear
- L. Never coast downhill
- M. Always park on level ground if possible
- N. Apply down pressure on bowl and block wheels, if necessary, to park on a grade
- O. Observe travel route for overpass clearances; be sure there is adequate clearance for ROPS, cab, or canopy

INFORMATION SHEET

X. Items to check on a daily inspection

A. Visual inspection for leaks or broken, worn, or missing parts

(NOTE: Write down on pad any repairs that are needed.)

B. Engine oil level

C. Radiator coolant level

D. Battery electrolyte level and battery cable connections

E. Fuel level

F. Hydraulic fluid level

G. Air cleaner

H. Wires, insulation, and connections

I. Drive belts for condition and adjustment

J. Fuel pump sediment bowl (where applicable)

K. Transmission fluid level

L. Exhaust system

M. Safety devices

N. Brakes

O. Tires

P. Planetary drive oil in each wheel

Q. Cleanliness of equipment

R. Windshield wipers and windshield (where applicable)

S. Major components and/or accessories

T. Cables, drums, and cable lifts (where applicable)

U. Check gauges for normal operation

V. Check controls for proper functioning

INFORMATION SHEET

XI. Procedures for servicing a scraper (Assignment Sheet #1)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Visually inspect for broken, worn or missing parts, and leaks

(NOTE: Report deficiencies to the maintenance shop.)

B. Check engine oil level, filter, lines, and hoses; add oil if needed

C. Check air cleaner filter (element); clean and service

D. Check engine coolant level, radiator cap, hose, and radiator; add coolant if necessary

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Check fuel level, fuel filters, and sediment bowl (where applicable); add fuel if necessary

F. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if necessary

(NOTE: Keep sparks and fire away from battery.)

G. Check exhaust system for loose connections and holes

H. Check hydraulic fluid level, filters, hose, lines, fittings, and leaks; add fluid if necessary

I. Check transmission fluid level; add fluid if necessary

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition, adjust if necessary

L. Check brake master cylinder fluid level; add fluid if necessary

M. Check clutch for proper adjustment; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace as necessary

O. Check wiring, insulation, and connections; repair or replace as necessary

P. Clean grease fittings and lubricate

Q. Check tire pressure and condition; adjust if necessary

INFORMATION SHEET

R. Check all safety devices for proper functioning

S. Check windshields and windshield wipers (where applicable)

T. Check major components and/or accessories

U. Add planetary drive oil to wheels if necessary

V. Check cables and drums (if applicable); adjust, repair, or replace when necessary

W. Check gauges and controls for proper functioning

SCRAPERS
UNIT II

ASSIGNMENT SHEET #1--LIST EQUIPMENT AND MATERIALS NEEDED TO PERFORM SERVICE ON A SCRAPER

NAME ______________________________ SCORE ____________________

List materials needed to perform service on a scraper. Use the Information Sheet in this unit and operator's guide for reference.

A. ____

B. ____

C. ____

D. ____

E. ____

F. ____

G. ____

H. ____

I. ____

J. ____

K. ____

L. ____

SCRAPERS
UNIT II

ANSWERS TO ASSIGNMENT SHEET

(NOTE: Types of lubricants may vary with different types and manufacturers of equipment. Lesson must be evaluated to the satisfaction of the instructor because of the different manufacturers and types of equipment.)

A. Tool kit and new parts if necessary

B. Engine oil

C. Engine coolant

D. Gasoline or diesel fuel

E. Hydraulic fluid

F. Electrolyte or water

G. Cleaning solution

H. Air supply and brake fluid

I. Tire pressure gauge

J. Transmission fluid

K. Planetary oil as specified by manufacturer

L. Shop rags and lubricating grease according to manufacturer's recommendations

SCRAPERS
UNIT II

JOB SHEET #1--START, WARM UP, CHECK GAUGES, AND TEST CONTROLS FOR PERFORMANCE; MAKE FINAL VISUAL CHECK

I. Equipment--Scraper

II. Procedure

A. Place all controls in neutral position

B. Turn master switch to "on"

C. Open fuel shut-off valve

D. Depress accelerator pedal lightly

E. Push starter button

(CAUTION: Never operate starter more than 30 seconds at a time. If engine fails to start, wait 2 to 5 minutes before cranking again.)

F. Check oil pressure light immediately (15 seconds) after engine starts; if no pressure, shut off engine and determine cause

G. Allow engine to warm up (5 minutes in summer, 10 to 15 in winter)

H. Check brake air pressure

I. Determine that all gauges are functioning properly

J. Manipulate controls to be sure all components are operating properly

K. Unlock gears and shift gears to low range

L. Engage clutch and accelerator

M. Manipulate controls to move scraper forward, back, and turn

N. Check service brake

O. Shift gears to neutral and lock

P. Make final visual check for leaks and listen for any abnormal knocks or noises

SCRAPERS
UNIT II

JOB SHEET #2–CUT, LOAD EARTH, MOVE TO FILL AREA, AND SPREAD

I. Equipment and materials–Scraper

II. Procedure

A. Travel to work site

(NOTE: Load downhill and in direction of fill when possible; see Figures 12 and 13.)

FIGURE 12

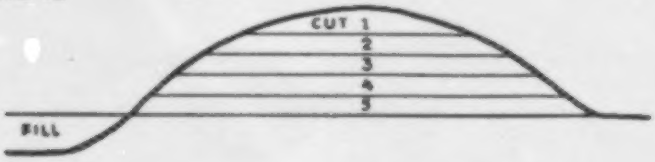
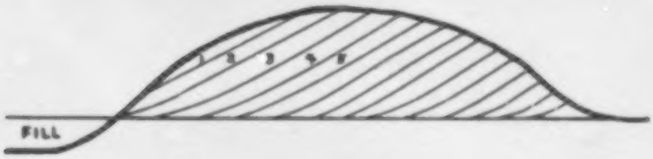


FIGURE 13



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B. Allow engine rpm to decrease; then, move shift control to proper range, and move into first cut

C. Set apron to proper position (if using an elevating scraper, set cutting edge)

(NOTE: Material density will determine depth of cut, elevator speed, and machine speed. Use a fast speed for loose material and a slow speed for dense material.)

D. Lower cutting edge gradually to desired cutting depth

(NOTE: Regulate depth of cut to load as quickly as possible without spinning wheels.)

JOB SHEET #2

E. Gradually raise cutting edge out of cut when bowl is nearly full, and close apron

F. Raise bowl just high enough to clear obstructions

G. Travel to fill area (Figure 14)

(NOTE: Move to fill area as quickly as possible, maintaining safety by reducing speed at corners and avoiding sharp turns.)

FIGURE 14

Courtesy of Caterpillar Tractor Company.

H. Enter fill area with bowl positioned at the desired thickness of spread

I. Maintain forward motion during ejection

J. Push ejection control lever to eject position until rolling floor is approximately one-half open

K. Spread about half of load

L. Move ejector lever as required to maintain constant flow of material

M. Continue until ejector cylinder has been extended to its full length and bowl is empty

N. Retract ejection system

O. Return to work site and start cycle again

SCRAPERS
UNIT II

JOB SHEET #3--STRIP TOPSOIL AND STOCKPILE

I. Equipment--Scraper (Figure 15)

FIGURE 15

II. Procedure

A. Determine area to be stripped and stockpile area

B. Move machine to work area

C. Down shift to loading speed

D. Open apron to desired height

E. Lower cutting edge to approximately 3" to 6"

(NOTE: Maintain level cut with little tire spinning.)

F. Close apron when loaded and raise bowl gradually to avoid a shelving effect at the end of cut

G. Move to stockpile area with bowl just high enough to avoid obstructions

H. Raise or lower bowl to desired depth of lift

I. Raise apron to full "open" position

JOB SHEET #3

J. Engage ejector lever to push or roll material toward apron opening, maintaining a smooth, constant flow of material

K. Lower apron when load is spread, and return ejector to full back position

L. Return to cut area and repeat cycle

(NOTE: It is very important to maintain outside limits of the stockpile higher than the middle to avoid scraper slipping over the edge.)

SCRAPERS
UNIT II

JOB SHEET #4--OPERATE SCRAPER, USING BULLDOZER AS PUSHER

I. Equipment

A. Scraper

B. Bulldozer

II. Procedure

A. Travel to work site

B. Locate dozer; allow engine rpm to decrease; then move shift control to proper range, and move to right side of the dozer

(NOTE: The dozer should be stopped at a slight angle to the cut.)

C. Continue forward, moving far enough in front of the dozer to turn to the left, thus enabling the machine to line up straight with the cut

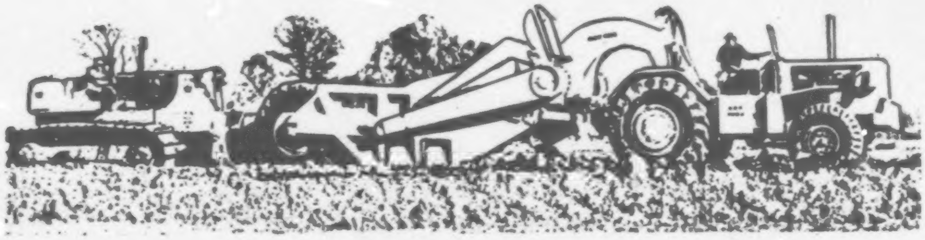
(NOTE: If at all possible, always move in from the right of the dozer so that the operator of the scraper can see the front of the dozer blade and avoid damage to tires or other parts.)

D. Continue forward lowering cutting edge to the desired depth of cut

E. Raise apron to permit material to be delivered into the bowl (Figure 16)

(NOTE: The dozer operator should have made pushing contact by this time.)

FIGURE 16



Used with permission of Caterpillar Tractor Company.

JOB SHEET #4

F. Maintain cut at desired depth, using throttle only to aid the machine and to provide hydraulic power for the attachments

G. Lower apron when bowl is full; gradually raise the cutting edge from the cut to avoid shelving at the end

H. Select travel gear and move to fill area as fast and safely as possible

I. Raise or lower bowl to desired depth of lift

J. Raise apron to full open position

K. Engage ejector lever to push or roll material toward apron opening, maintaining a smooth constant flow of materials

L. Lower apron when load is spread, and return ejector to full back position

M. Return to cut area and repeat cycle

SCRAPERS
UNIT II

JOB SHEET #5--FINISH GRADE A PAD

I. Equipment

- A. Scraper (Figure 17)
- B. Grade checker

FIGURE 17

Courtesy of Caterpillar Tractor Company.

II. Procedure

- A. Walk completely around machine to be sure no one is near or under machine
- B. Mount machine using steps and grab irons
- C. Sit in seat and secure seat belt

  (NOTE: Engine has already been warmed up, checked, and is running, with brake and transmission locked.)
- D. Release parking brake and transmission lock
- E. Raise bowl to safe travel height
- F. Select safe travel speed and begin moving machine

JOB SHEET #5

G. Travel to work area, observing traffic patterns

H. Approach work area and downshift to a safe working speed

I. Observe grade checker's hand signals and lower bowl to begin cutting finish grade

(NOTE: If fill is to be made, you must first load bowl with material either from stockpile or a previous cut.)

J. Continue cutting or filling, observing grade checker's signals and making necessary corrections, until bowl is full or empty

K. Shut apron when loaded and raise bowl slowly out of cut to avoid a benching effect on the end

L. Raise bowl to safe travel height and proceed to spread area or stockpile

M. Lower bowl to amount of lift to be added (observe grade checker); select correct speed, and raise apron to open position; begin ejecting material from bowl

N. Return to work area when load is spread, and again observe grade checker

(NOTE: It may be necessary to move to opposite side of work area to continue finish grade cutting.)

O. Line up on next cut area by putting one wheel on previous cut

P. Select proper working speed and lower bowl to begin cut

Q. Observe grade checker's hand signals and proceed to make cut

R. Continue cutting, making necessary adjustments in depth, until bowl is full or job is completed

SCRAPERS
UNIT II

JOB SHEET #6--SHUT DOWN SCRAPER

I. Equipment--Scraper

II. Procedure

A. Manipulate controls to effect shutdown

B. Reduce travel speed

C. Move scraper to designated parking area

D. Depress brake to stop machine

E. Put gears in neutral position

F. Apply safety lock

G. Manipulate controls to lower scraper bowl and apron

H. Push cushion control to lock down position

I. Place brake lever in park position

J. Idle engine for cool-down period (three to five minutes)

K. Turn switch off to stop engine (close throttle)

L. Close fuel shut-off valve

M. Remove key

N. Report any malfunctions to supervisor

SCRAPERS
UNIT II

TEST

NAME______________________________ SCORE____________________

1. List uses of scrapers.

a. ____

b. ____

____

2. Match terms associated with scrapers to their correct definitions. Write the correct numbers in the blanks.

_____a. Time required to load, haul, dump, spread, and return to loading position

_____b. Time given to loading, dumping, turning, accelerating, and decelerating

_____c. Remove overburden or thin layers of material

_____d. Ground that forms a natural or artificial incline

_____e. Earth put into a pile and saved for future use

_____f. Deposit of soil valuable enough to stockpile for future use

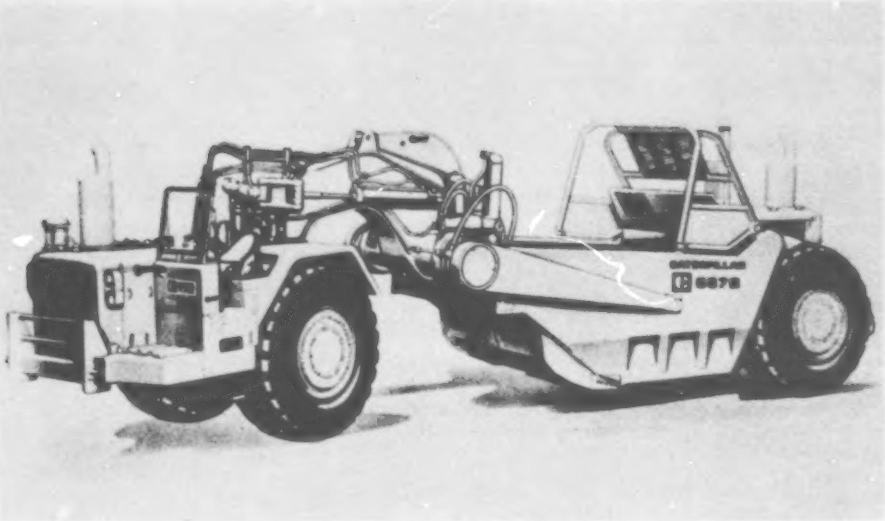
_____g. Person who checks grades and signals operator

_____h. Rollover protective structure

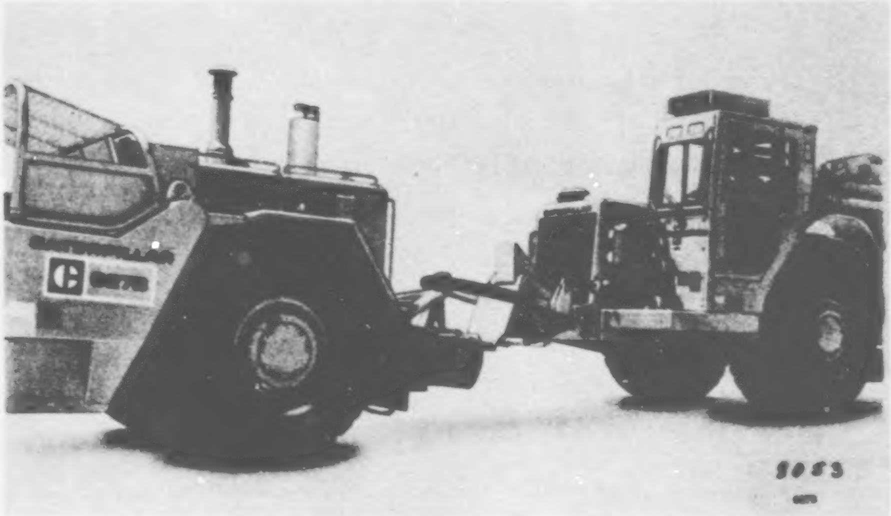
1. Stockpile
2. Strip
3. Cycle time
4. Slope
5. Fixed time
6. Pay material (formation)
7. Grade checker
8. ROPS

TEST

3. Label types of scrapers. Write the correct names in the blanks.

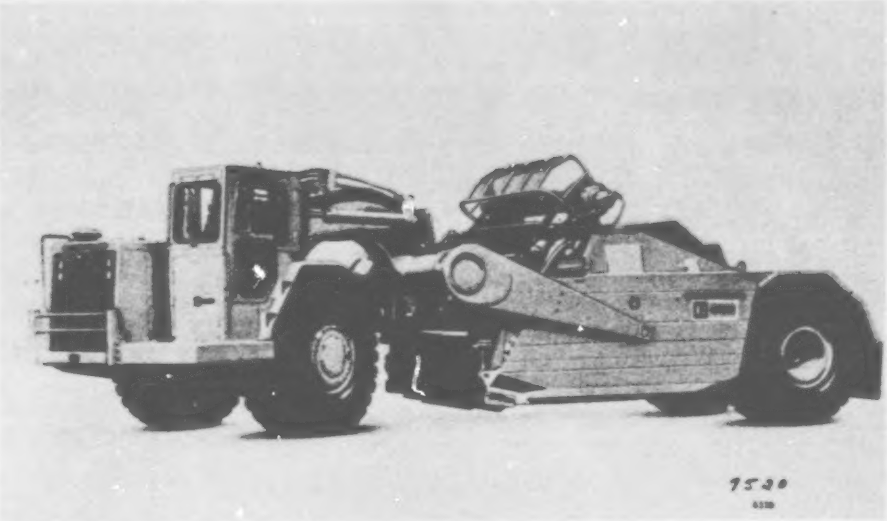


a. ______________________________

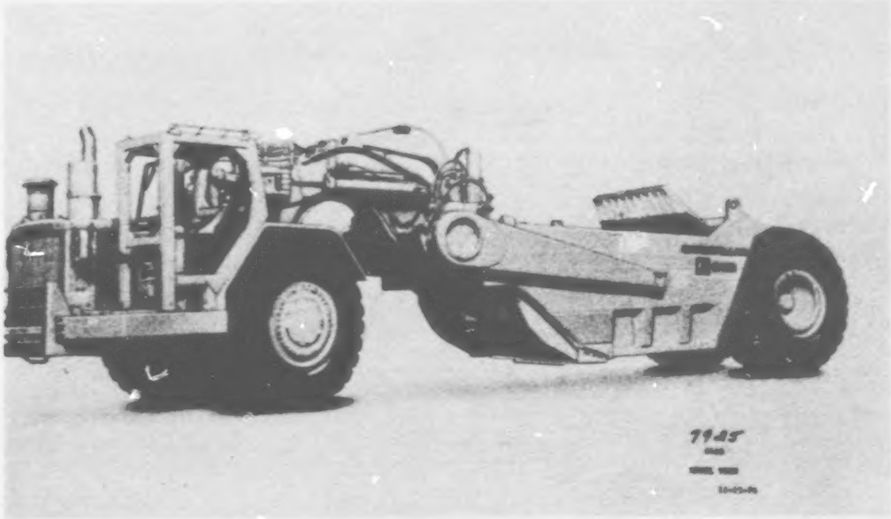


b. ______________________________

TEST

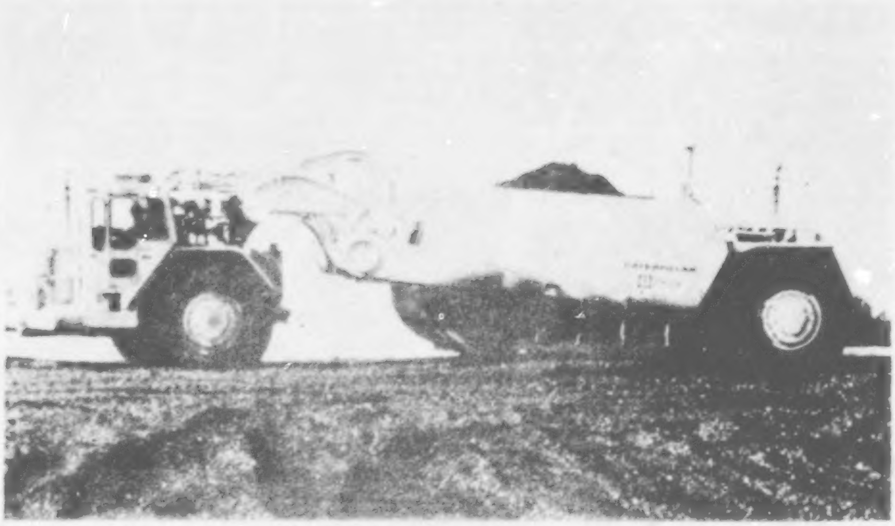


c. ______________________________

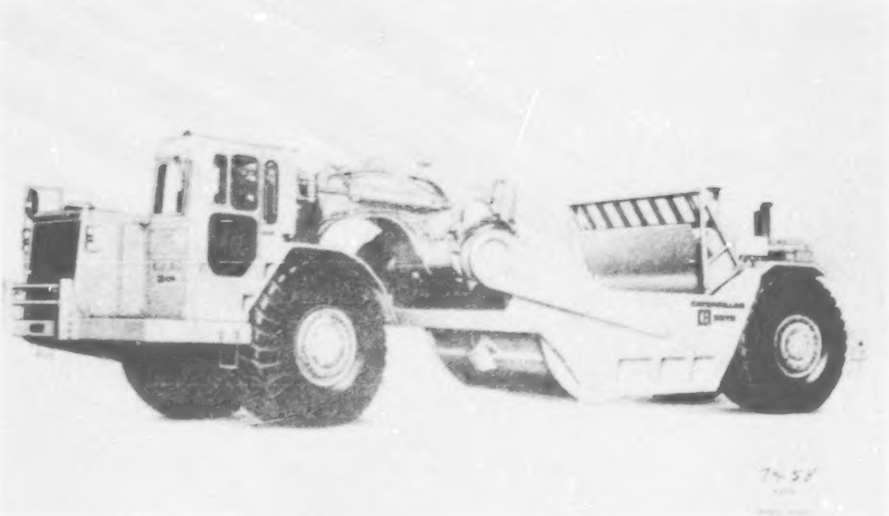


d. ______________________________

TEST



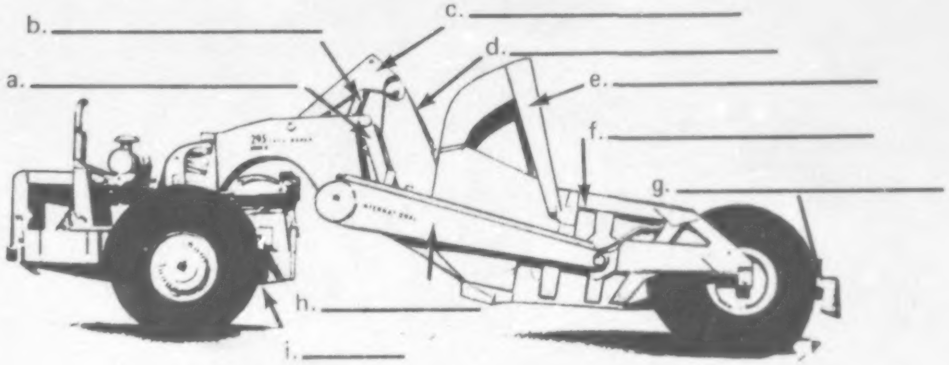
e. ______________________________



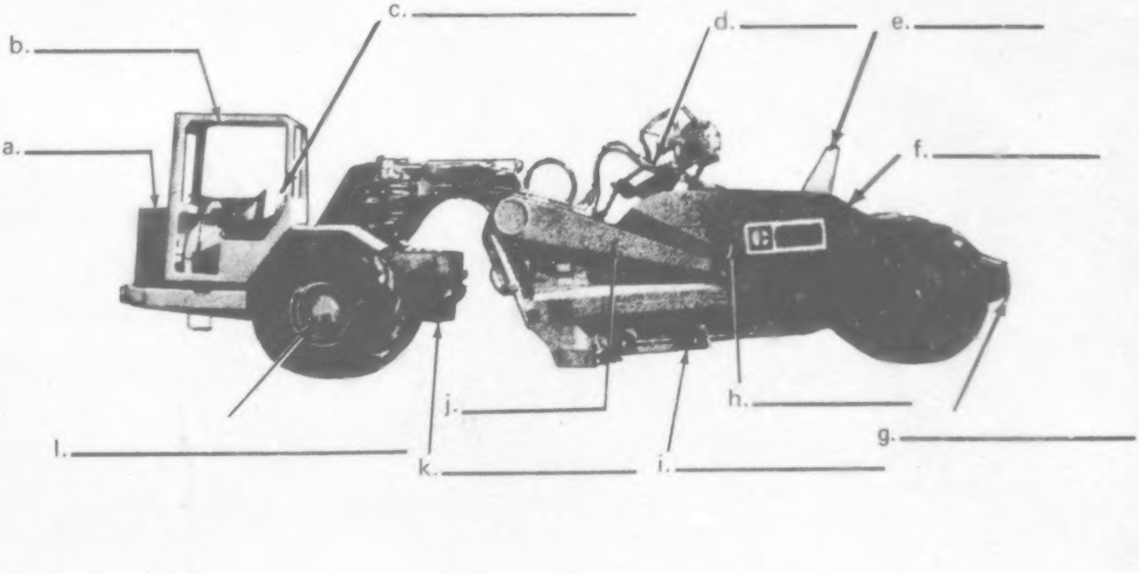
f. ______________________________

TEST

4. Label parts of a standard wheel tractor scraper. Write the correct names in the blanks.

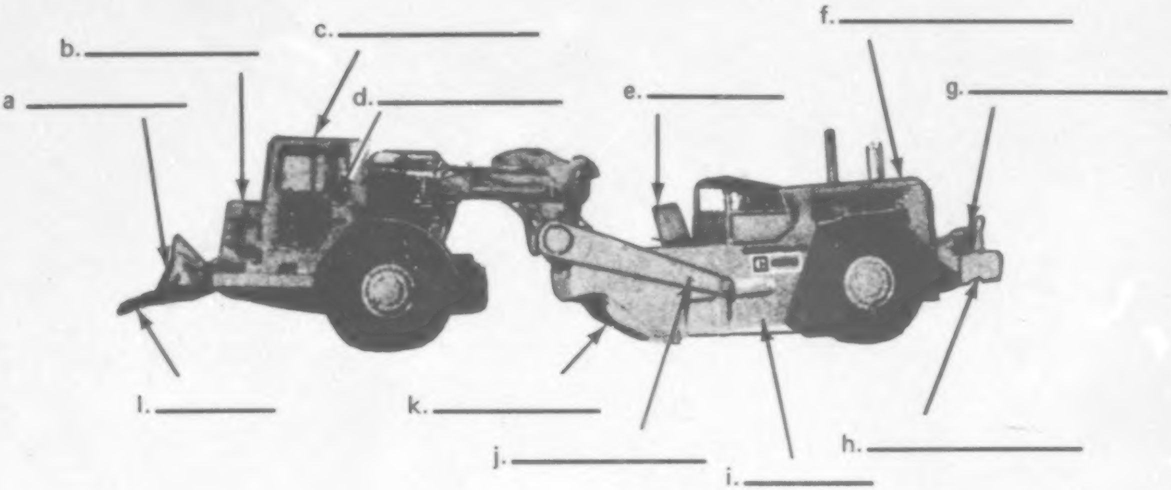


5. Label parts of the elevating wheel tractor scraper. Write the correct names in the blanks.


c. ______
d. ______
e. ______
b. ______
a. ______
f. ______
j. ______
h. ______
g. ______
l. ______
k. ______
i. ______

TEST

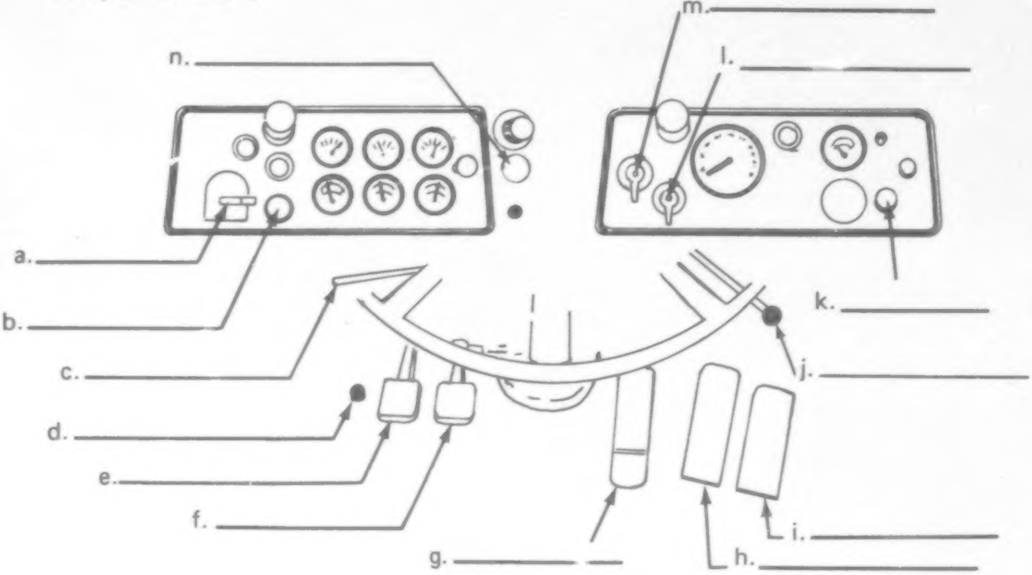
6. Label parts of a push-pull wheel tractor scraper. Write the correct names in the blanks.

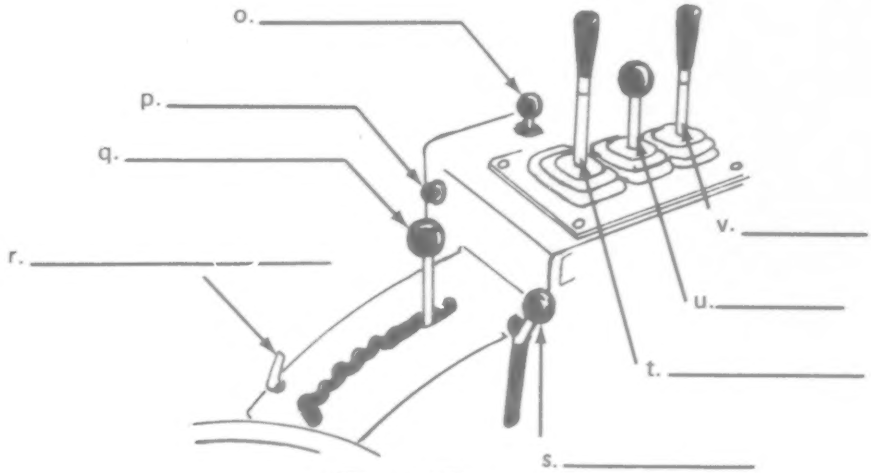

a ____________
b. ____________
c. ____________
d. ____________
e. ____________
f. ____________
g. ____________
h. ____________
i. ____________
j. ____________
k. ____________
l. ____________

TEST

7. Identify controls on a typical tractor-scraper. Write the correct names in the blanks.

Transmission control lever safety lock
Disconnect switch
Service brake pedal
Differential lock
Bail hitch control
Transmission hold
Fuel ratio override
Ejector control
Tractor engine heat-start switch
Scraper engine stop button
Scraper accelerator
Light dimmer switch
Individual wheel brake lever
Horn button
Parking brake control
Transmission control lever
Governor override button
Apron control
Scraper engine heat-start switch
Tractor accelerator
Single lever bowl-apron control





TEST

8. State five suggestions for effective scraper operations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

9. State ten safety precautions to observe while operating a scraper.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

10. Select from the following list items to check on a daily inspection. Write an "X" in the blank before each correct answer.

_____a. Radiator core

_____b. Hydraulic fluid level

_____c. Visual inspection for leaks or broken, worn, or missing parts

_____d. Clutch plates

_____e. Transmission fluid level

_____f. Planetary drive oil in each wheel

_____g. Major components and/or accessories

_____h. Engine oil level

_____i. Wires, insulation, and connections

TEST

______j. Tires

______k. Wheel bearings

______l. Radiator coolant level

11. Select from the following list procedures for servicing a scraper. Write an "X" in the blank before each correct answer.

______a. Check battery electrolyte level, battery cables, and connectors; add water or electrolyte if necessary

______b. Check transmission fluid level; add fluid if necessary

______c. Add air to spare tires; check valves and treads

______d. Add grease to planetary drive on each wheel

______e. Check drive belts for tension and wear; adjust or replace as necessary

______f. Lubricate all grease fittings; then clean

______g. Check controls and replace if required

______h. Check brake adjustment and condition; adjust if necessary

______i. Check air cleaner filter (element); clean and service

______j. Report broken or missing items to police

______k. Check wiring, insulation, and connections; repair or replace as necessary

______l. Check engine oil level, filter, lines, and hoses; add oil if needed

(NOTE: Test questions 12 and 13 list assignment and job sheets. These are an important part of this test. If they have not been completed, check with your instructor.)

12. List equipment and materials needed to perform service on a scraper.

13. Demonstrate the ability to

a. Start, warm up, check gauges, and test controls for performance; make final visual check.

b. Cut, load earth, move to fill area, and spread.

c. Strip topsoil and stockpile.

d. Operate scraper, using bulldozer as pusher.

e. Finish grade a pad.

f. Shut down scraper.

SCRAPERS
UNIT II

ANSWERS TO TEST

1. Answer should include the following
   a. Earth moving (loading and hauling)
   b. Spreading materials (depositing loads in thick layers and cutting off high spots)

2. a. 3
   b. 5
   c. 2
   d. 4
   e. 1
   f. 6
   g. 7
   h. 8

3. a. Tandem-powered wheel tractor scraper
   b. Push-pull wheel tractor scraper
   c. Elevating wheel tractor scraper
   d. Standard wheel tractor scraper
   e. Special type coal scraper
   f. Elevating tandem-powered wheel tractor scraper

4. a. Bowl lift cylinders
   b. Apron lift cylinder
   c. Apron lift arm
   d. Apron lift cable
   e. Apron
   f. Bowl
   g. Ejector cylinder location
   h. Draft frame
   i. Tractor

5. a. Engine
   b. ROPS
   c. Scraper controls
   d. Elevator
   e. Ejector
   f. Fuel tank
   g. Push block
   h. Bowl
   i. Ejector floor
   j. Draft frame
   k. Transmission
   l. Differentials and final drives

ANSWERS TO TEST

6. a Push plate
   b. Tractor engine
   c. Operator's cab
   d. Bail control
   e. Ejector
   f. Scraper engine
   g. Bail hook
   h. Push block
   i. Bowl
   j. Draft arm
   k. Apron
   l. Bail

7. a. Parking brake control
   b. Horn button
   c. Individual wheel brake lever
   d. Light dimmer switch
   e. Transmission hold
   f. Differential lock
   g. Service brake pedal
   h. Scraper accelerator
   i. Tractor accelerator
   j. Retarder lever
   k. Scraper engine stop button
   l. Scraper engine heat-start switch
   m. Tractor engine heat-start switch
   n. Governor override button
   o. Fuel ratio override
   p. Disconnect switch
   q. Transmission control lever
   r. Transmission control lever safety lock
   s. Bail hitch control
   t. Single lever bowl-apron control
   u. Apron control
   v. Ejector control

8. Answer should include any five of the following
   a. Do not work machine over capacity
   b. Dump and spread material at highest practical travel speed
   c. Up shift and travel at highest practical speed for return to cut
   d. Use extreme care when turning on a down grade
   e. Service equipment regularly to ensure efficient operation
   f. Keep equipment clean
   g. Set up work cycle so that it will be as short as possible
   h. Calculate and plan operations before starting

ANSWERS TO TEST

9. Answer should include any ten of the following
    a. Wear safety items required by job conditions
    b. Know and observe hand signals
    c. Be sure machine is equipped with clearance lights and flags
    d. Be sure all safety guards and covers are secured in place
    e. Check all safety devices before starting machine
    f. Do not jump onto or from moving equipment
    g. Do not allow anyone to ride on machine
    h. Know traffic pattern of job and obey signal person
    i. Stay clear of all danger areas (electrical, slide areas, and overhangs)
    j. Use extra caution when crossing side hills, ridges, ditches and any other obstacles
    k. Do not back machine until you are sure personnel and obstructions are clear
    l. Never coast downhill
    m. Always park on level ground if possible
    n. Apply down pressure on bowl and block wheels, if necessary, to park on a grade
    o. Observe travel route for overpass clearances; be sure there is adequate clearance for R.O.P.S., cab, or canopy

10. b, c, e, f, g, h, i, j, l

11. a, b, e, h, i, k, l

12. Evaluated to the satisfaction of the instructor

13. Performance skills evaluated to the satisfaction of the instructor

BULLDOZERS
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a bulldozer to perform basic, intermediate, and difficult jobs. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of bulldozers.
2. Match terms associated with bulldozers to the correct definitions.
3. Label basic parts of a bulldozer.
4. Identify controls on a typical bulldozer.
5. List types of accessories used on or with bulldozers.
6. List safety procedures to use when operating a bulldozer.
7. Select from a list items to check on a daily inspection.
8. State suggestions for effective dozer operation.
9. Select from a list items to check when servicing a bulldozer.
10. List materials needed to service a bulldozer.
11. Demonstrate the ability to
    a. Start, warm up, check gauges, and test controls for performance; make final visual check.
    b. Perform winching operations (remove a stump).
    c. Perform winching operations on a vehicle that is stuck in mud.
    d. Use bulldozer to pull a roller.
    e. Perform rough ditching and spreading.
    f. Perform job moving large boulder.
    g. Perform ripping operations.

OBJECTIVE SHEET

h. Cut and build a gentle slope bench.

i. Perform excavation work in confined area.

j. Perform finish work.

k. Use bulldozer in unstable soils.

l. Use bulldozer as pusher.

m. Use bulldozer to pull a disc.

BULLDOZERS
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order films or other materials planned to supplement unit.

      (NOTE: Equipment manufacturers are good sources for films and other materials pertaining to particular pieces of equipment.)

   B. Provide students with objective sheet.

   C. Provide students with information, assignment, and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Stress to students that manipulation of controls and operating procedures may differ with certain models and different manufacturers.

   H. Provide alternative jobs if job sheets are not practical.

   I. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment Sheet #1--List Materials Needed to Service a Bulldozer

   E. Answers to assignment sheet

   F. Job sheets

      1. Job Sheet #1--Start, Warm Up, Check Gauges, and Test Controls for Performance; Make Final Visual Check

      2. Job Sheet #2--Perform Winching Operations (Remove a Stump)

      3. Job Sheet #3--Perform Winching Operations on a Vehicle that is Stuck in Mud

      4. Job Sheet #4--Use Bulldozer to Pull a Roller

SUGGESTED ACTIVITIES

5. Job Sheet #5--Perform Rough Ditching and Spreading

6. Job Sheet #6--Perform Job Moving Large Boulder

7. Job Sheet #7--Perform Ripping Operations

8. Job Sheet #8--Cut and Build a Gentle Slope Bench

9. Job Sheet #9--Perform Excavation Work in Confined Area

10. Job Sheet #10--Perform Finish Work

11. Job Sheet #11--Use Bulldozer in Unstable Soils

12. Job Sheet #12--Use Bulldozer as Pusher

13. Job Sheet #13--Use Bulldozer to Pull a Disc

G. Test

H. Answers to test

III. Unit references

A. Nichols, H. L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

B. *1150C Crawler: Operator's Manual 9-6451.* Racine, Wisconsin: JI Case Company, 1978.

C. *Handbook of Ripping,* 6th ed. Peoria, Illinois: Caterpillar Tractor Co., 1976.

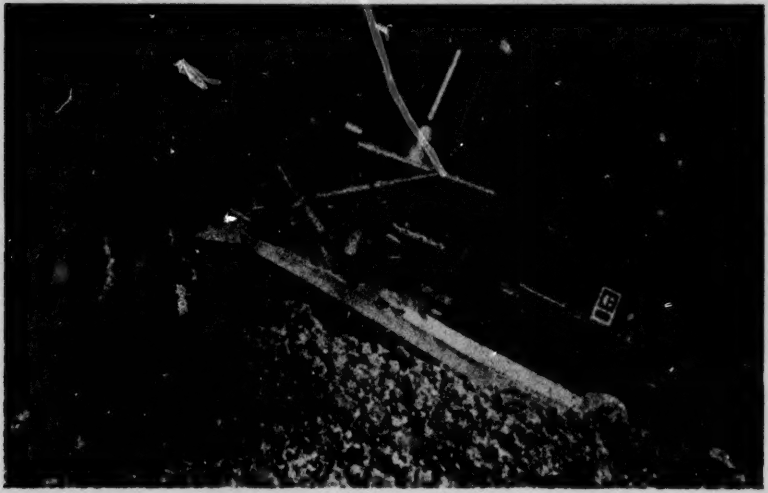
BULLDOZERS
UNIT III

INFORMATION SHEET

I. Uses of bulldozers (Figure 1)

(NOTE: Bulldozers are manufactured in a wide range of sizes.)

FIGURE 1



A. Excavate, cut, fill, backfill, and spread

B. Maintain haul roads and pilot roads through rocky terrain

C. Clear construction sites of debris, clear land, and demolish stumps

D. Tow accessory equipment

INFORMATION SHEET

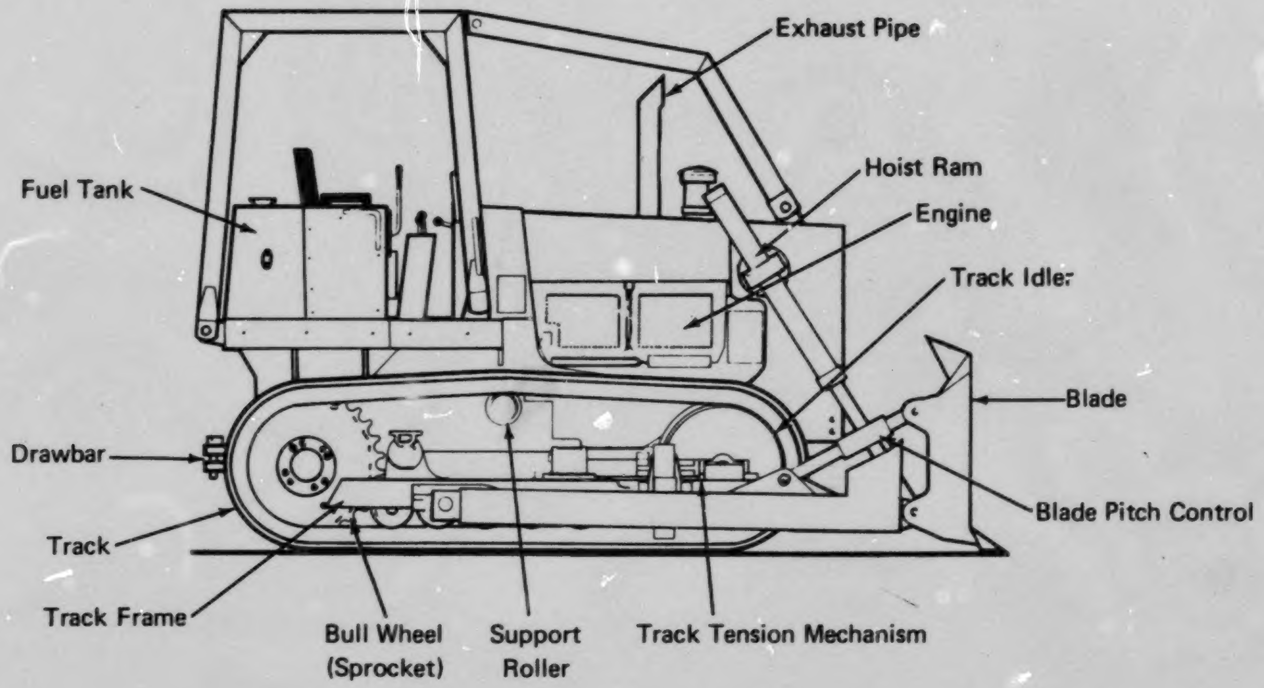
II. Terms and definitions

- A. Accessories--Attachments used to increase the effectiveness of a machine's use
- B. Winch--Power control unit used to pull equipment and to remove stumps
- C. Stripping--Removal of overburden or thin layers of pay material
- D. Stockpile--Material put into a pile and saved for future use
- E. Ripping--Loosening hard soil, concrete, or soft rock
- F. Demolition--Smashing or breaking into pieces
- G. Grubbing--Digging out roots
- H. Unstable soils--Muddy and swampy earth
- I. Grouser--Ridge or cleat across a track shoe which improves its grip on the ground

INFORMATION SHEET

III. Basic parts of a bulldozer (Figure 2)

FIGURE 2

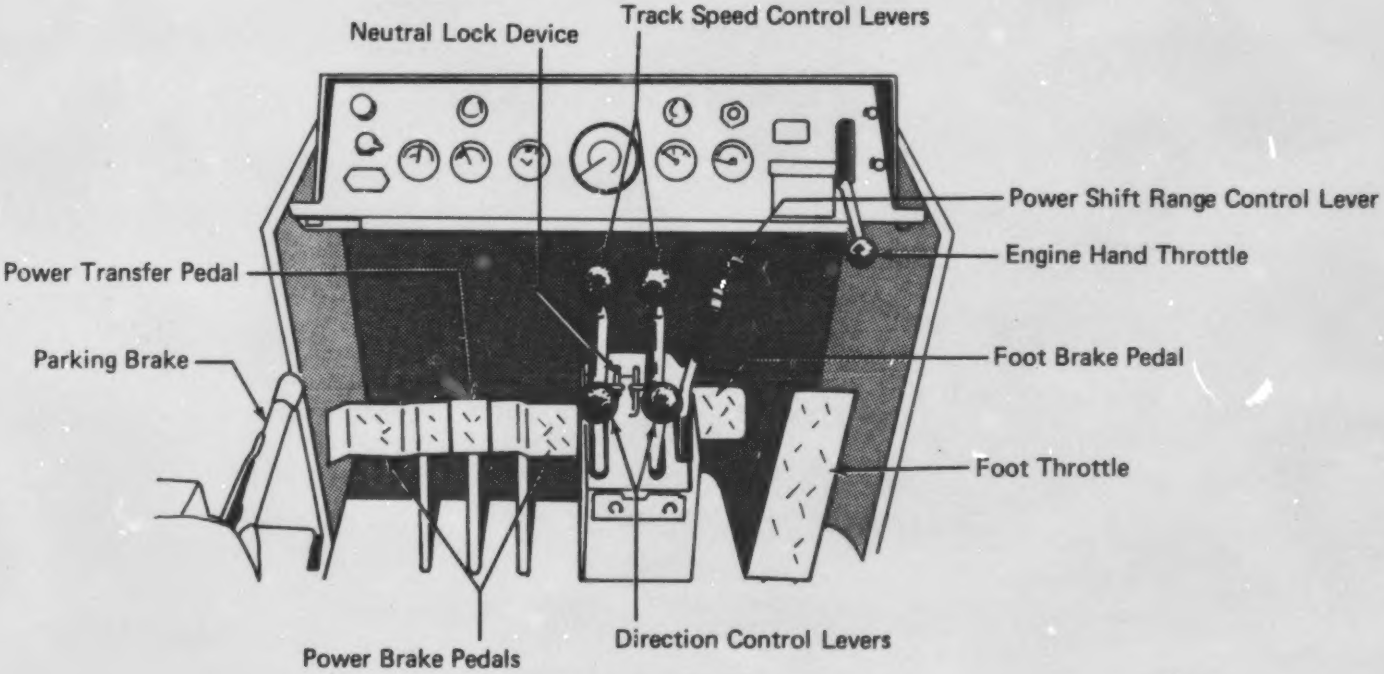

Exhaust Pipe
Fuel Tank
Hoist Ram
Engine
Track Idler
Blade
Drawbar
Blade Pitch Control
Track
Track Frame
Bull Wheel (Sprocket)
Support Roller
Track Tension Mechanism

Used with permission of JI Case, a Tenneco Company.

INFORMATION SHEET

IV. Controls on a typical bulldozer (Figure 3)

FIGURE 3


Neutral Lock Device
Track Speed Control Levers
Power Shift Range Control Lever
Engine Hand Throttle
Power Transfer Pedal
Parking Brake
Foot Brake Pedal
Foot Throttle
Power Brake Pedals
Direction Control Levers

Used with permission of JI Case, a Tenneco Company.

INFORMATION SHEET

V. Accessories used on or with bulldozers

- A. Straight blade
- B. Angle blade
- C. U-blade
- D. Cushion blade
- E. S-blade
- F. Cable plow
- G. Backhoe
- H. V-blade
- I. Rake blade
- J. Multiple-shank ripper
- K. Root plow
- L. Towing attachment
- M. Winch
- N. Rocker shovel
- O. Side-boom
- P. Drill
- Q. Bucket
- R. Pusher plate
- S. Stumper
- T. Tree shears
- U. Root rake
- V. Rolling chopper
- W. Rotary mixer
- X. Towing grapple
- Y. Disc

INFORMATION SHEET

VI. Safety procedures to use when operating a bulldozer

(NOTE: Bulldozers are complex and powerful machines that require complete attention for proper control during operation.)

- A. Keep machine clean
- B. Wear required protective clothing and safety items
- C. Never remove protective guards or panels
- D. Know and respond to hand signals given by signal person
- E. Mount equipment carefully
- F. Never leave operator's cab with engine running
- G. Be sure everyone is clear before moving machine
- H. Never allow riders on dozer
- I. Comply with all local, state, and federal regulations when working around power lines
- J. Always travel with the blade low
- K. Never park on an incline
- L. Wear seat belts at all times

VII. Items to check on a daily inspection

- A. Possible broken, worn, or missing parts, and leaks

  (NOTE: Write down on paper any repairs that are needed.)
- B. Engine oil level
- C. Engine coolant level
- D. Battery electrolyte level and battery cable connections
- E. Fuel level
- F. Hydraulic fluid level
- G. Air cleaner
- H. Wires, insulation, and connections
- I. Condition and adjustment of drive belts
- J. Fuel pump sediment bowl (where applicable)
- K. Transmission fluid level

INFORMATION SHEET

L. Exhaust system

M. Safety devices

N. Tracks

O. Cleanliness of equipment

P. Windshield wipers and windshield (where applicable)

Q. Major components and/or accessories

R. Normal operation of gauges

S. Proper functioning of controls

VIII. Suggestions for effective dozer operation

(NOTE: The following are suggestions to improve operating efficiency.)

A. Keep equipment clean

B. Service equipment regularly to ensure efficient operation

C. Calculate and plan operations before starting

D. Set up work cycle so that it will be as short as possible

E. Observe all safety rules and regulations

F. When grading, stop occasionally and spread material

(NOTE: Usually, it is easier to spread several small piles than one big pile.)

IX. Items to check when servicing a bulldozer (Assignment Sheet #1)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Possible broken, worn, or missing parts, and leaks

(NOTE: Report deficiencies to the maintenance shop.)

B. Engine oil level, filter, lines, and hoses

C. Air cleaner filter (element)

D. Engine coolant level, radiator cap, hose, and radiator

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Fuel level, fuel filters, and sediment bowl (where applicable)

INFORMATION SHEET

F. Battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Exhaust system

H. Hydraulic fluid level, filters, hose, lines, fittings, and possible leaks

I. Transmission fluid level

J. Transmission pressure line filter and breather

K. Adjustment and condition of brakes

L. Brake master cylinder fluid level

M. Clutch for proper adjustment

N. Drive belts for tension and possible wear

O. Wiring, insulation, and connections

P. Grease fittings

Q. Tires or tracks

R. All safety devices

S. Windshield wipers (where applicable)

T. Major components and/or accessories

U. Track drive chains and pads

V. Tracks; clean out dirt if necessary

W. Gauges and controls for proper functioning

BULLDOZERS
UNIT III

ASSIGNMENT SHEET #1--LIST MATERIALS NEEDED TO SERVICE A BULLDOZER

NAME ______________________________ SCORE ______________

Using the Information Sheet in this unit, list materials needed to perform service on a bulldozer.

A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

E. ______________________________

F. ______________________________

G. ______________________________

H. ______________________________

I. ______________________________

J. ______________________________

BULLDOZERS
UNIT III

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

(NOTE: Types of lubricants may vary with different types of equipment and manufacturers. This lesson must be evaulated to the satisfaction of the instructor because of the different manufacturers and types of equipment.)

A. Tool kit and necessary new parts

B. Engine oil

C. Engine coolant

D. Diesel fuel or gasoline

E. Hydraulic fluid

F. Water

G. Cleaning solution

H. Brake fluid

I. Transmission fluid

J. Lubricating grease according to manufacturer's recommendation

BULLDOZERS
UNIT III

JOB SHEET #1--START, WARM UP, CHECK GAUGES, AND TEST CONTROLS FOR PERFORMANCE; MAKE FINAL VISUAL CHECK

I. Equipment--Bulldozer

II. Procedure

A. Apply brakes and lock

B. Lock transmission lever in neutral

C. Turn disconnect switch to "on"

D. Adjust governor control lever to proper starting position

E. Engage starter

(CAUTION: Never operate starter more than 30 seconds at a time. If engine fails to start, wait 2 to 5 minutes before trying again.)

F. Allow engine to warm up (5 minutes in summer; 10 to 15 minutes in winter)

G. Determine that all gauges are functioning properly

H. Pull the blade control lever to raise and lower blade

I. Unlock brakes

J. Depress accelerator pedal and move speed selector lever to first forward gear

K. Manipulate controls to be sure all components are operating properly

L. Reduce engine speed

M. Move speed selector lever to neutral and apply brake

N. Lock speed selector lever in neutral

O. Apply brakes and lock

P. Dismount bulldozer and make final visual check

BULLDOZERS
UNIT III

JOB SHEET #2--PERFORM WINCHING OPERATIONS (REMOVE A STUMP)

I. Equipment

   A. Bulldozer

   B. Winch equipment

   C. Stump

   D. Chain

   E. Gloves

II. Procedure

   A. Mount bulldozer using steps and grab irons

   B. Sit in operator's seat and secure safety belt

   C. Raise blade to clear obstacles

   D. Release parking brakes and transmission lock

   E. Select first gear and move to stump

   F. Position bulldozer so that blade-side of bulldozer is away from stump

   G. Place transmission in neutral and lock

   H. Set both track brakes

   I. Release winch jaw clutch

   (NOTE: Brake should be set with a slight drag.)

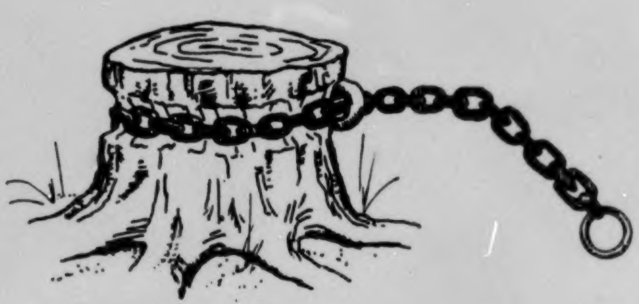
   J. Release seat belt and dismount using steps and grab irons

JOB SHEET #2

K. Attach chain to stump (Figure 4)

(NOTE: A groove should be cut in stump before chain is attached; see Figure 4.)

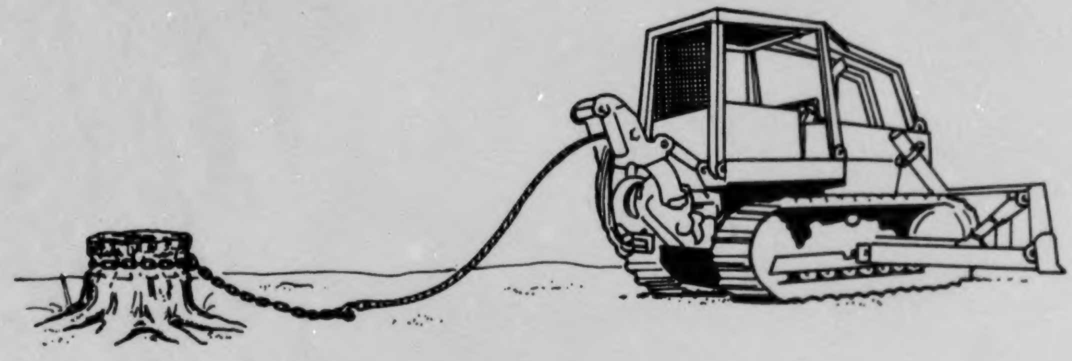
FIGURE 4



L. Move to winch hook and release

M. Pull cable to stump and attach to chain (Figure 5)

FIGURE 5



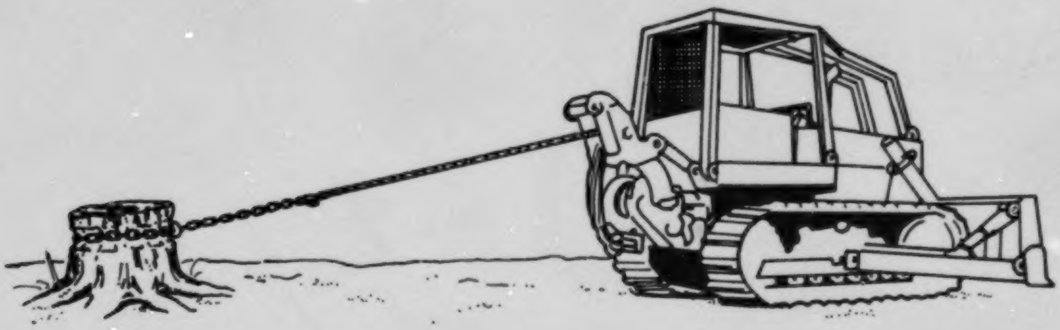
N. Remount bulldozer using steps and grab irons

O. Sit in operator's seat and secure seat belt

JOB SHEET #2

P. Re-engage winch jaws and take up slack in line (Figure 6)

FIGURE 6



Q. Increase engine rpm and apply power

R. Observe winch to be sure cable is feeding onto drum correctly

(NOTE: The stump may come out or the tractor may be pulled toward the stump. If the tractor is pulled toward the stump, it will probably be necessary to anchor the tractor by using blocks or a chain attached to a solid object. Sometimes it is possible to place the machine in gear and spin down until a bank is created behind the tractor; use this for leverage. Usually, one of these methods is effective enough to remove the stump.)

S. Release brake when stump is pulled out; place winch in locked position and release transmission lock

T. Place bulldozer in first forward gear and drag stump to brush pile

U. Stop bulldozer and select first reverse gear; back up until there is enough slack to unhook cable

V. Stop; place transmission in locked position; lower blade to ground; set parking brake

W. Release seat belt, and dismount using steps and grab irons

X. Remove cable and chain from stump

Y. Remount machine; place winch in gear, observing to see that cable is feeding onto drum correctly, until all cable is on drum

Z. Disconnect winch, and dismount using steps and grab irons

AA. Secure cable by placing cable hook in eye

BULLDOZERS
UNIT III

JOB SHEET #3--PERFORM WINCHING OPERATIONS ON A VEHICLE THAT IS STUCK IN MUD

I. Equipment (Figure 7)

A. Bulldozer

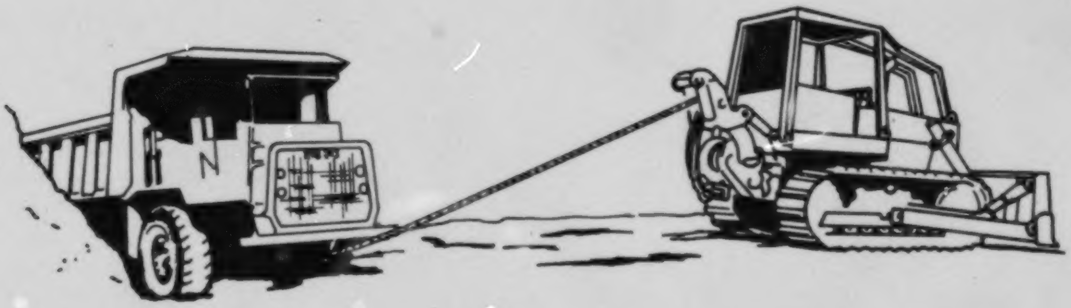
B. Winching equipment

C. Truck

D. Cable

E. Gloves

FIGURE 7



II. Procedure

(NOTE: Before starting procedures, make observation of stuck vehicle and decide method of completing the job.)

A. Mount bulldozer using steps and grab irons

B. Sit in operator's seat and secure safety belt

C. Raise blade just enough to clear obstacles

D. Release parking brakes and transmission lock

E. Select first gear and move to truck

JOB SHEET #3

F. Back bulldozer into position for attaching cable to truck

G. Place transmission in neutral and lock

H. Set both track brakes

I. Release winch jaw clutch and set brake with a slight drag

J. Release seat belt and dismount using steps and grab irons

K. Move to winch hook and release

L. Pull cable to truck and attach to tow hook

M. Inform truck driver of the procedures you are going to use to free truck

N. Remount bulldozer using steps and grab irons

O. Sit in operator's seat and secure seat belt

P. Re-engage winch jaws and take up slack in line

Q. Increase engine rpm and apply power

(NOTE: When power is applied, truck driver should have truck in gear with wheels driving.)

R. Observe winch to be sure cable is feeding onto drum correctly

(NOTE: The truck may come out, or the tractor may be pulled toward the truck. If the tractor is pulled toward the truck, it is sometimes possible to place the machine in gear and spin down until a bank is created behind the tractor; use this for leverage. If this method does not work, it will probably be necessary to anchor the tractor by using blocks or a chain attached to a solid object.)

S. Release brake; place winch in locked position and release transmission lock

T. Place bulldozer in first forward gear and increase engine rpm

U. Continue pulling until truck is completely clear of the mud

(NOTE: When both vehicles are free, stop both vehicles.)

V. Select first reverse gear; back up toward truck until there is enough slack to unhook cable

JOB SHEET #3

W. Have truck driver remove cable from truck

X. Place winch in gear, observing to see that cable is feeding onto drum correctly, until all cable is on drum

Y. Disconnect winch and secure machine

Z. Place transmission in locked position; lower blade to ground; set parking brake and shut off machine

AA. Dismount machine; secure cable by placing cable hook in eye

BULLDOZERS
UNIT III

JOB SHEET #4--USE BULLDOZER TO PULL A ROLLER

(NOTE: Operator is to use bulldozer to pull roller and penetrate only about 1 inch into the material.)

I. Equipment and material

A. Roller

B. Bulldozer

II. Procedure

A. Mount bulldozer using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Raise blade off ground to clear obstacles

[illegible] Release brake and transmission lock

E. Select first forward gear and travel to where roller is parked

F. Line up in front of roller

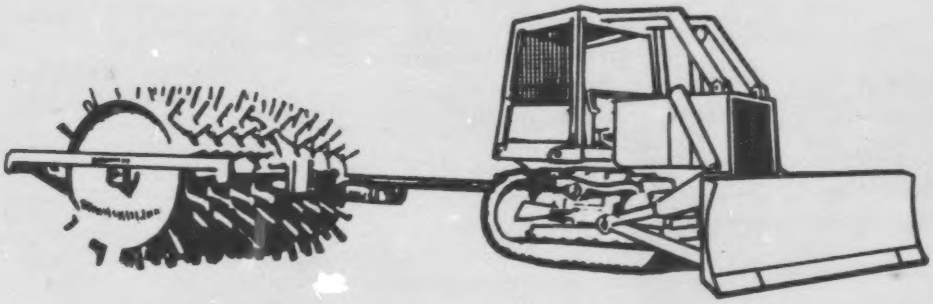
G. Select first reverse gear and slowly move backwards

(NOTE: Observe backward movement, alignment of roller tongue, and people assisting with connection of roller.)

H. Stop bulldozer immediately when signal person gives signal

I. Complete connections (Figure 8)

FIGURE 8



JOB SHEET #4

J. Depress decelerator and brake

K. Place transmission in neutral position

L. Select first forward gear and travel to work area

M. Observe forward speed and align right side of roller with right side of pad

(NOTE: The pad to be compacted is an area 50 feet wide by 100 feet long and has had a lift of moist clay 1 foot deep evenly spread over it.)

N. Travel straight ahead the length of pad

O. Maintain low engine speed to provide proper speed but to avoid engine lugging

P. Approach end of pad, and gradually turn left

Q. Align roller with right edge of pad end

(NOTE: Care must be taken during turn to avoid kicking out material on right side of tracks, thus causing irregularities on pad.)

R. Select first reverse gear and slowly move backward over area that was missed when turn was made

(NOTE: When backing, turn in seat and observe backward movement; observe when bottom of roller drum reaches edge of pad.)

S. Select first forward gear and slowly move forward

T. Continue this procedure completely around pad, and then proceed to next pass, overlapping one-half of first pass

BULLDOZERS
UNIT III

JOB SHEET #5--PERFORM ROUGH DITCHING AND SPREADING

I. Equipment--Bulldozer with angle blade

II. Procedure

A. Mount bulldozer using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Raise blade to travel position

D. Release brake and transmission lock

E. Shift to appropriate gear and travel to work area

F. Select first forward gear and begin tilting down the leading cutting edge

G. Lower blade to ground and begin ditch

H. Raise blade slightly to allow machine to level out as the bulldozer tracks walk into the cut

I. As the machine levels out, lower blade to continue ditching

J. Tilt blade to allow material to be sidecast up the sides of ditch

K After one side of ditch is cut, turn bulldozer around and repeat cycle on return pass

BULLDOZERS
UNIT III

JOB SHEET #6–PERFORM JOB MOVING LARGE BOULDER

I. Equipment

  A. Bulldozer

  B. Large boulder

II. Procedure

  A. Mount bulldozer using steps and grab irons

  B. Sit in operator's seat and secure seat belt

  C. Raise blade off ground to clear obstacles

  D. Release brake and transmission lock

  E. Select first forward gear and travel to work area

  F. Approach large rock and tilt blade to make contact with ground at edge of boulder

  G. Push rock at full power to dislodge it

  H. Once rock has turned, stop and reverse direction

  I. Stop and select first forward gear; line blade up on rock

  J. Lower blade to ground and push rock out of the way

  K. If rock is too large to push all at once, line bulldozer up on one end; push forward and lift blade slowly

  (NOTE: The rock should roll out on one end.)

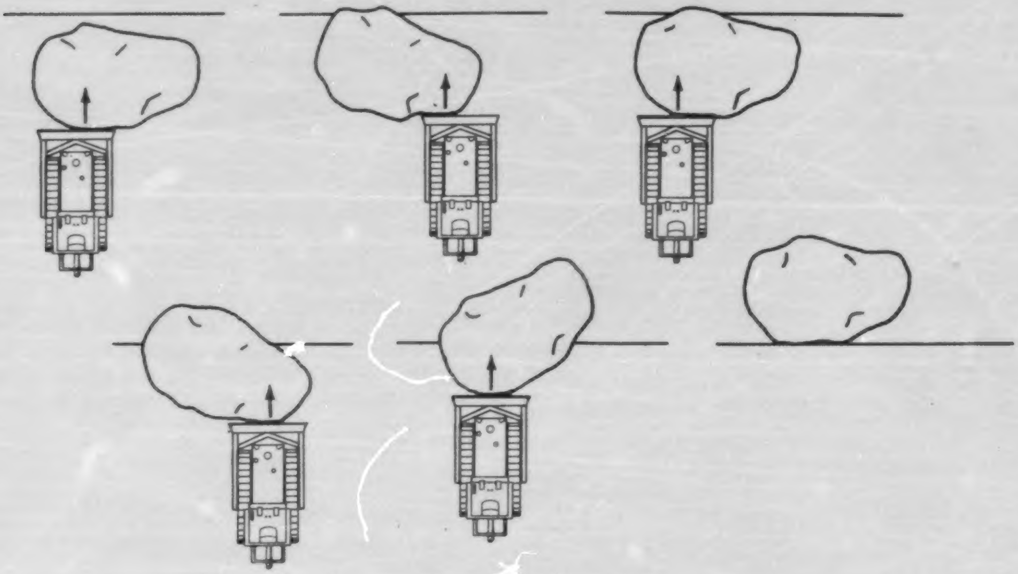
  L. Reverse direction and line up on other end

JOB SHEET #6

M. Select first forward gear and lower blade to ground on other end; to roll end out, push forward and raise blade at same time

(NOTE: If stone is too large to move by direct pushing, it can be pushed first on one side and then on the other side; see Figure 9.)

FIGURE 9



N. Continue this procedure until boulder is removed

BULLDOZERS
UNIT III

JOB SHEET #7--PERFORM RIPPING OPERATIONS

I. Equipment

   A. Bulldozer

   B. Multiple ripper attachment

II. Procedure

   A. Mount bulldozer using steps and grab irons

   B. Sit in operator's seat and secure seat belt

   C. Pull throttle to high engine speed and decelerate with decelerator pedal

   D. Raise blade to clear obstructions

   E. Release brake and transmission lock, and select travel gear

   F. Release pressure on decelerator pedal, and travel to area to be ripped

   G. Select first forward gear; begin lowering rippers as you approach work area

   (NOTE: Use hand control or foot pedals to lower rippers.)

JOB SHEET #7

H. Lower rippers into material until engine begins to lug and bulldozer starts to spin tracks (Figure 10)

(NOTE: Never try to steer bulldozer with rippers lowered.)

FIGURE 10

Courtesy of Caterpillar Tractor Company.

I. Raise the rippers to ease the strain on the machine and the rippers

(NOTE: To aid in the breakout of materials, some prefer to raise and lower slightly on the move.)

J. Raise ripper to full "up" and decelerate engine as bulldozer reachos the end of area

K. Move transmission from first forward gear to first reverse gear

L. Return to starting area, being careful to look behind and watch where you are going

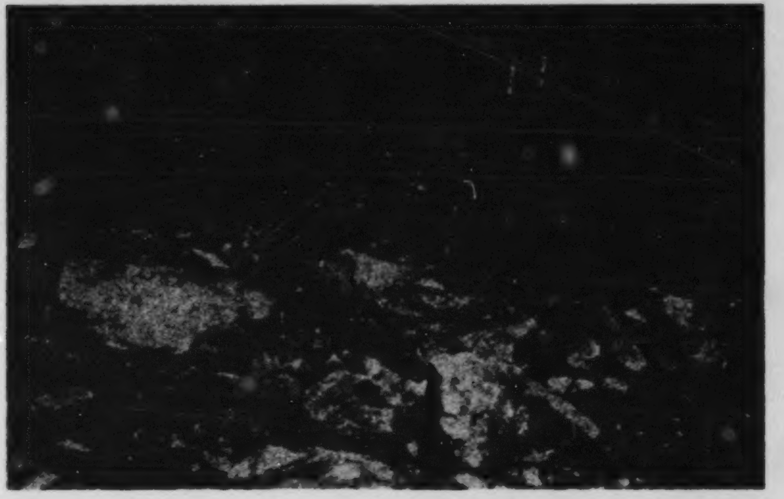
M. Repeat cycle until area is ripped to satisfaction of instructor

BULLDOZERS
UNIT III

JOB SHEET #8--CUT AND BUILD A GENTLE SLOPE BENCH

I. Equipment--Bulldozer (Figure 11)

FIGURE 11



Courtesy of Caterpillar Tractor Company.

II. Procedure

A. Mount bulldozer using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Pull throttle to high engine speed and decelerate with decelerator pedal

D. Raise blade to clear obstructions

E. Release brake and transmission lock, and select travel gear

F. Release pressure and decelerator pedal; travel to the top of hill

G. Approach slope stakes on top of bench

H. Lower blade and begin cutting down the hill, maintaining slope ratio

I. When blade becomes full and the bulldozer begins to stall, raise the blade and lose the material

JOB SHEET #8

J. Place machine in reverse, and return to the top of hill

K. Shift into forward and lower blade; continue cutting, maintaining proper slope ratio

L. When blade becomes full, begin to raise the blade gradually to allow the front of the machine to begin levelling

M. Lower blade to maintain level grade, and as machine begins to level out, lose the material

N. Place bulldozer in reverse, and return to the top of bench

O. Move bulldozer over one blade width and continue cycle until bench is the proper depth

(CAUTION: When making a cut, be sure to maintain slope ratio.)

BULLDOZERS
UNIT III

JOB SHEET #9--PERFORM EXCAVATION WORK IN CONFINED AREA

I. Equipment

   A. Bulldozer with tilt blade

   B. String line staked on two sides between obstructions

II. Procedure

   A. Mount bulldozer using steps and grab irons

   B. Sit in operator's seat and secure seat belt

   C. Raise blade to travel position

   D. Release brake and transmission lock

   E. Set throttle to high engine speed

   F. Decelerate engine with foot pedal

   G. Shift to appropriate gear

   H. Travel to area to be excavated

   I. Line bulldozer blade edge up on inside of stringline

   J. Lower blade to ground, keeping bulldozer well back from edge of excavation to allow for ramping down into excavation

   K. Select first forward gear and begin cutting a shallow lift of material

   L. When blade becomes full, raise blade to ground level and push material outside of excavation

      (NOTE: Ride load over undug ground.)

   M. Raise blade, and shift to reverse

   N. Return to area where the blade was lifted

   O. Lower blade to ground, and shift to first forward gear

   P. Repeat cycle until layer is cut

   Q. Raise blade gradually to begin ramping out on opposite end

   R. To maintain a smooth slope, lower blade as tracks begin climbing out

JOB SHEET #9

S. Raise blade gradually to lose material

T. Shift to reverse, and return to opposite side

U. Continue cycle until proper depth is reached

BULLDOZERS
UNIT III

JOB SHEET #10--PERFORM FINISH WORK

I. Equipment--Bulldozer with tilt blade

II. Procedure

   A. Mount bulldozer using steps and grab irons

   B. Sit in operator's seat and secure seat belt

   C. Raise blade to travel position

   D. Release brake and transmission lock

   E. Pull throttle to high engine speed

   F. Decelerate and shift to first forward gear

   G. Travel to work site

   H. Lower blade to ground observing ahead of machine for high spots and gullies

   I. Raise and lower blade very slightly to maintain a level footing for tractor

   J. Tilt and steer machine to skim materials from high spots to low areas

   K. Raise blade gradually to lose materials

   L. Shift to reverse, and travel back to starting point

   M. Move bulldozer over one blade width

   N. Repeat cycle until area is cleaned up

   O. Move machine to edge of area and lower blade

   P. Select first reverse gear and place blade in "float" position

   Q. Back up over area to be smoothed

   R. When area has been traversed, raise blade to travel position

   S. Select travel gear and steer bulldozer to opposite edge

   T. Move bulldozer over three-quarters of blade width

   U. Repeat cycle until area is smooth and free of loose dirt, piles, or grouser prints

BULLDOZERS
UNIT III

JOB SHEET #11--USE BULLDOZER IN UNSTABLE SOILS

I. Equipment--Wide-gauge dozer (low ground pressure) (Figure 12)

FIGURE 12

Courtesy of Caterpillar Tractor Company.

II. Procedure

- A. Mount bulldozer using steps and grab irons
- B. Sit in operator's seat and secure seat belt
- C. Raise blade to travel position (12 to 18 inches off ground)
- D. Release brake and transmission lock
- E. Pull hand throttle to full open
- F. Decelerate engine
- G. Shift to appropriate gear
- H. Position bulldozer to one side of muddy area; travel to work area
- I. Downshift to first forward gear
- J. Lower blade to just skim a shallow layer of mud

JOB SHEET #11

K. Dig cautiously to avoid sinking tractor

(CAUTION: Avoid spinning track; when you lose traction stop and wait for someone to pull you out.)

L. Push mud far back because the bulldozer cannot climb on it to make high piles

M. Shift to reverse gear

N. Back bulldozer to starting position, and line up with next pass

O. Shift gears to first forward gear, and lower blade to skim mud

P. Position blade approximately one-half the width of previous pass to avoid material slopping off onto completed pass

Q. Push material far back, raising blade slightly to allow material to flow out in an even spread

R. Shift to reverse gear and travel back to start of area

S. Repeat cycle until area is cleared of mud

BULLDOZERS
UNIT III

JOB SHEET #12--USE BULLDOZER AS PUSHER

I. Equipment

   A. Bulldozer

   B. Scraper

II. Procedure

   A. Mount bulldozer using steps and grab irons

   B. Sit in operator's seat and secure seat belt

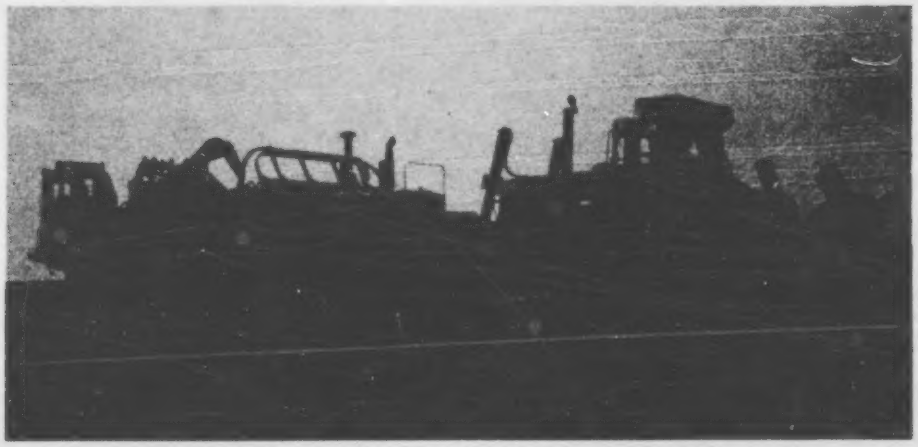
   C. Travel to work site

   D. Locate scraper; allow rpm to decrease; select proper gear, and move toward scraper

   E. Line up directly behind scraper and position blade to push

   F. Downshift to first gear and decelerate to soften contact (Figure 13)

FIGURE 13



Courtesy of Caterpillar Tractor Company.

   G. On contact with scraper, accelerate to full power

   H. Continue pushing and watching scraper bowl to see when bowl is full

JOB SHEET #12

I. Signal scraper operator when bowl is full

(NOTE: Signal is "thumbs-up" on left hand.)

J. Decelerate as scraper pulls away from bulldozer

K. Place transmission in reverse as bulldozer stops

L. Look behind bulldozer, and back up to starting area; reposition dozer for pushing next scraper

BULLDOZERS
UNIT III

JOB SHEET #13--USE A BULLDOZER TO PULL A DISC

I. Equipment

A. Dozer with drawbar (Figure 14)

B. Disc

FIGURE 14

Courtesy of Caterpillar Tractor Company.

II. Procedure

A. Mount dozer using steps and grab irons

B. Fasten seat belt

C. Raise blade; release brake and transmission lock

D. Raise disc travel wheels to the full-up position

JOB SHEET #13

E. Select forward travel speed gear and move forward

(NOTE: Plan a travel system in your mind and stick to it. Avoid unnecessary steering and countersteering--both take away from the efficiency of the dozer and cause production delays.)

(CAUTION: If work area requires crossing a line or hard surface road, stop short of the object to be crossed; rubber tires under the tracks of the dozer will protect the object. The disc must be raised to clear the object because of its width, cutting depth, and angle at which the discs travel.)

F. Stop forward travel and lower disc travel wheels; travel forward over object, raise disc travel wheels, and proceed forward

(NOTE: When discing to blend materials required by specifications, it may be necessary to travel parallel to objects to assure full coverage and blending in areas that would be missed by raising disc out of ground to travel over objects.)

G. Upon completion, stop forward travel and lower disc travel wheels to ground, raising the disc out of the ground

H. Travel to equipment parking area, lower blade to ground, place transmission in neutral, and set transmission lock; raise disc travel wheels up to lower weight of disc onto ground

I. Shut engine off, then operate disc control until all movement is out of system, with disc and travel wheels both resting on ground

(CAUTION: Disc blades create a possible hazard if allowed to remain in the "up" position.)

J. Unlock seat belt and dismount using steps and grab irons

BULLDOZERS
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. List uses of bulldozers.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

2. Match terms associated with bulldozers to their correct definitions. Write the correct numbers in the blanks.

_____a. Attachments used to increase the effectiveness of a machine's use

_____b. Power control unit used to pull equipment and to remove stumps

_____c. Removal of overburden or thin layers of pay material

_____d. Material put into a pile and saved for future use

_____e. Loosening hard soil, concrete, or soft rock

_____f. Smashing or breaking into pieces

_____g. Digging out roots

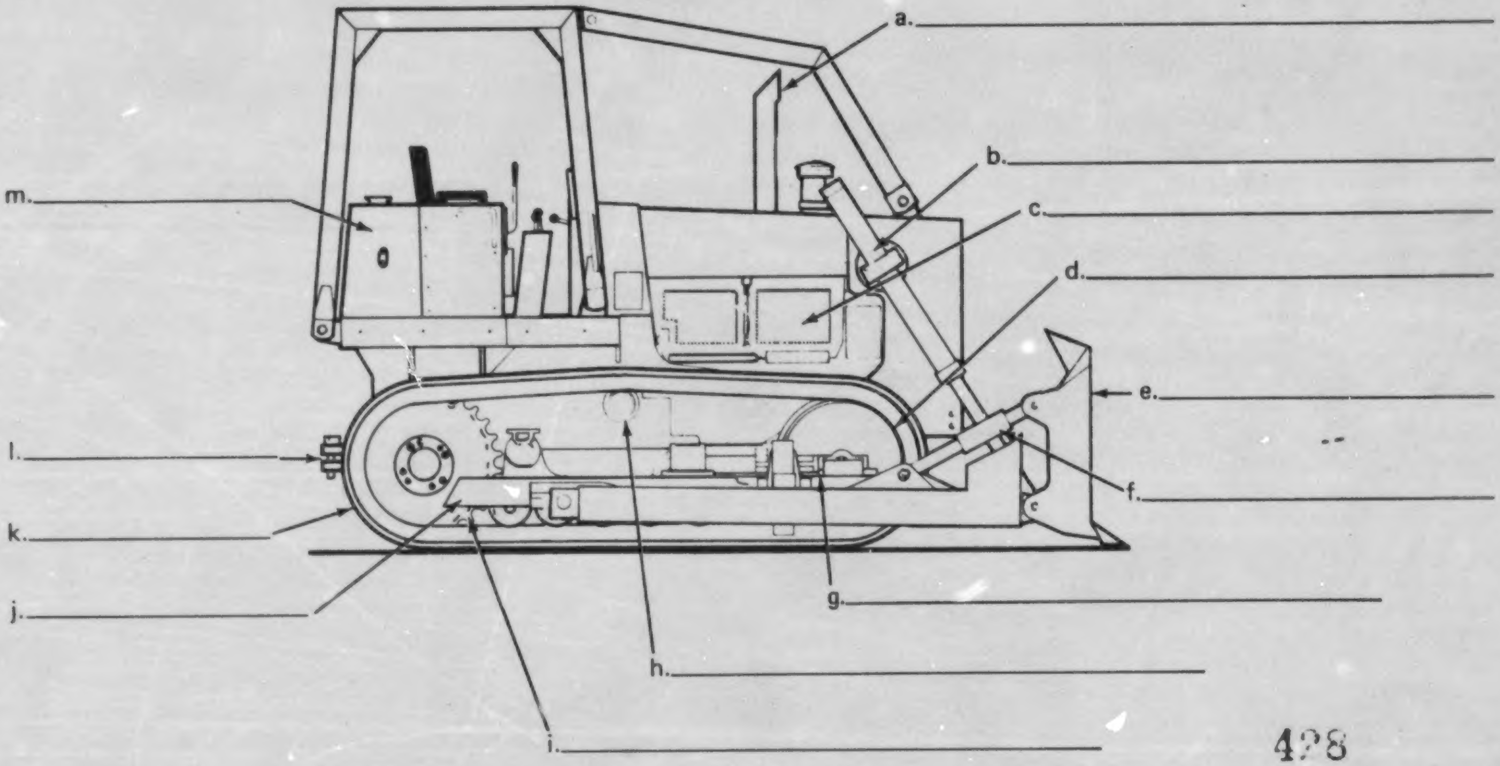
_____h. Muddy and swampy earth

_____i. Ridge or cleat across a track shoe which improves its grip on the ground

1. Demolition
2. Stockpile
3. Accessories
4. Unstable soils
5. Grouser
6. Stripping
7. Ripping
8. Grubbing
9. Winch

TEST

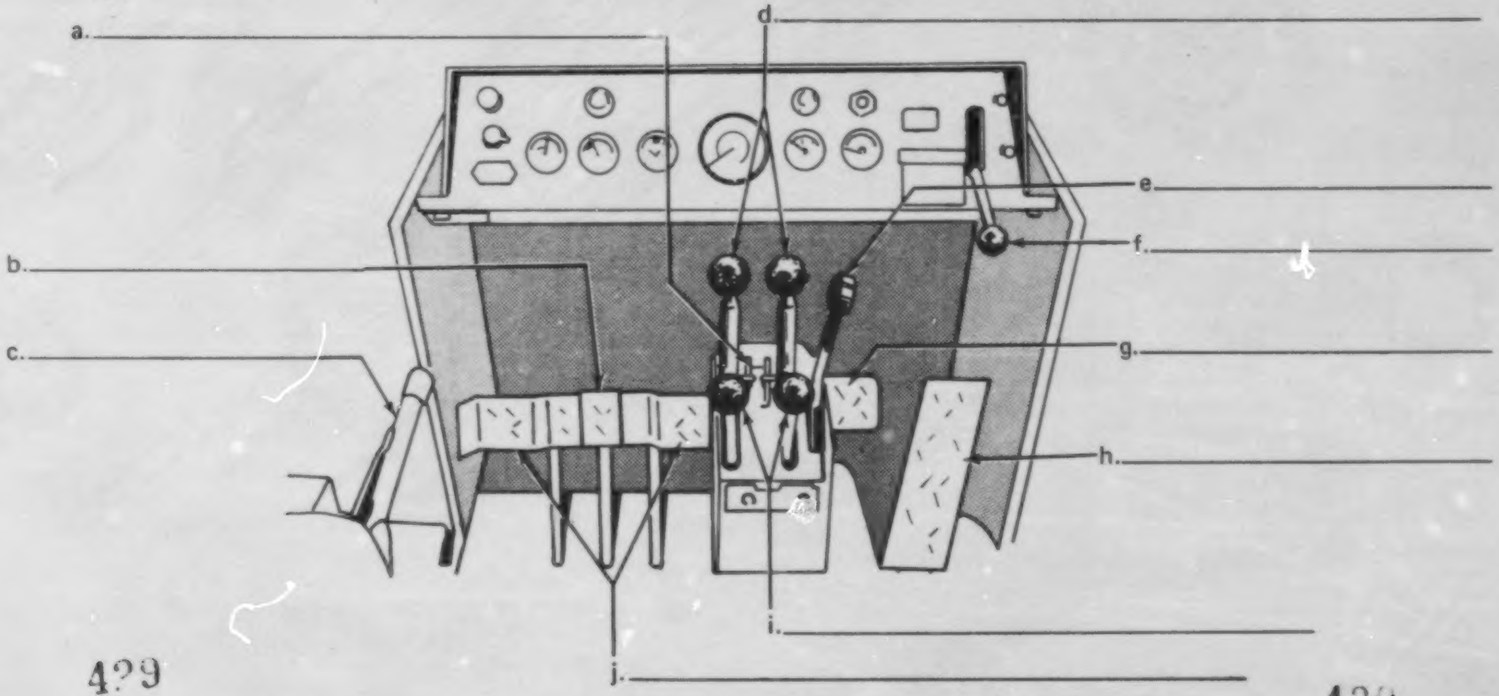
3. Label the basic parts of the bulldozer illustrated below. Write the correct names in the blanks.


a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.
m.

TEST

4. Identify controls on a bulldozer. Write the correct names in the blanks.

- **Neutral lock device**
- **Track speed control levers**
- **Power transfer pedal**
- **Parking brake**
- **Power shift range control lever**
- **Engine hand throttle**
- **Foot brake pedal**
- **Foot throttle**
- **Direction control levers**
- **Power brake pedals**



TEST

5. List ten types of accessories used on or with bulldozers.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

   e. ____________________

   f. ____________________

   g. ____________________

   h. ____________________

   i. ____________________

   j. ____________________

6. List eight safety procedures to use when operating a bulldozer.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

   e. ____________________

   f. ____________________

   g. ____________________

   h. ____________________

7. Select from the following list items to check on a daily inspection. Write an "X" in the blank before each correct answer.

   _____a. Air cleaner

   _____b. Chain adjustment

   _____c. Proper functioning of controls

   _____d. Hydraulic fluid level

   _____e. Blade adjustment

TEST

______f. Wires, insulation, and connections

______g. Air pressure

______h. Track shift pattern

______i. Engine coolant level

______j. Hydraulic track adjuster

______k. Belt fittings

______l. Planetary transmission

8. State five suggestions for effective dozer operation.

a. ____

b. ____

c. ____

d. ____

e. ____

9. Select from the following list items to check when servicing a bulldozer. Write an "X" in the blank before each correct answer.

______a. Transmission fluid; add to engine if needed

______b. Fuel level, fuel filters, and sediment bowl (where applicable)

______c. Drive belts for tension and possible wear

______d. Track shift pattern

______e. Adjustment and condition of brakes

______f. Angle of blade

______g. Grease fittings

______h. Drawbar

______i. Hoist ram

______j. Track drive chains and pads

______k. Bull wheel air pressure; adjust if needed

TEST

(NOTE: Test questions 10 and 11 are the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. List materials needed to service a bulldozer.

11. Demonstrate the ability to

    a. Start, warm up, check gauges, and test controls for performance; make final visual check.

    b. Perform winching operations (remove a stump).

    c. Perform winching operations on a vehicle that is stuck in mud.

    d. Use bulldozer to pull a roller.

    e. Perform rough ditching and spreading.

    f. Perform job moving large boulder.

    g. Perform ripping operations.

    h. Cut and build a gentle slope bench.

    i. Perform excavation work in confined area.

    j. Perform finish work.

    k. Use bulldozer in unstable soils.

    l. Use bulldozer as pusher.

    m. Use bulldozer to pull a disc.

BULLDOZERS
UNIT III

ANSWERS TO TEST

1. a. Excavate, cut, fill, backfill, and spread

b. Maintain haul roads and pilot roads through rocky terrain

c. Clear construction sites of debris, clear land, and demolish stumps

d. Tow accessory equipment

2. a. 3

b. 9

c. 6

d. 2

e. 7

f. 1

g. 8

h. 4

i. 5

3. a. Exhaust pipe

b. Hoist ram

c. Engine

d. Track idler

e. Blade

f. Blade pitch control

g. Track tension mechanism

h. Support roller

i. Bull wheel (sprocket)

j. Track frame

k. Track

l. Drawbar

m. Fuel tank

4. a. Neutral lock device

b. Power transfer pedal

c. Parking brake

d. Track speed control levers

e. Power shift range control lever

f. Engine hand throttle

g. Foot brake pedal

h. Foot throttle

i. Direction control levers

j. Power brake pedals

ANSWERS TO TEST

5. Answer should include any ten of the following
    a. Straight blade
    b. Angle blade
    c. U-blade
    d. Cushion blade
    e. S-blade
    f. Cable plow
    g. Backhoe
    h. V-blade
    i. Rake blade
    j. Multiple-shank ripper
    k. Root plow
    l. Towing attachment
    m. Winch
    n. Rocker shovel
    o. Side-boom
    p. Drill
    q. Bucket
    r. Pusher plate
    s. Stumper
    t. Tree shears
    u. Root rake
    v. Rolling chopper
    w. Rotary mixer
    x. Towing grapple
    y. Disc

6. Answer should include any eight of the following
    a. Keep machine clean
    b. Wear required protective clothing and safety items
    c. Never remove protective guards or panels
    d. Know and respond to hand signals given by signal person
    e. Mount equipment carefully
    f. Never leave operator's cab with engine running
    g. Be sure everyone is clear before moving machine
    h. Never allow riders on dozer
    i. Comply with all local, state, and federal regulations when working around power lines

ANSWERS TO TEST

- j. Always travel with the blade low
- k. Never park on an incline
- l. Wear seat belts at all times

7. a, c, d, f, i

8. Answer should include any five of the following
   - a. Keep equipment clean
   - b. Service equipment regularly to ensure efficient operation
   - c. Calculate and plan operations before starting
   - d. Set up work cycle so that it will be as short as possible
   - e. Observe all safety rules and regulations
   - f. When grading, stop occasionally and spread material

9. b, c, e, g, j

10. Evaluated to the satisfaction of the instructor
11. Performance skills evaluated to the satisfaction of the instructor

FRONT-END LOADERS
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a front-end loader to perform several types of jobs. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of front-end loaders.
2. Match terms associated with front-end loaders to the correct definitions.
3. List types of front-end loaders.
4. Label parts of loaders.
5. Identify controls for a typical wheel-type front-end loader.
6. List accessories used on front-end loaders.
7. List types of jobs done with loaders.
8. List safety procedures to use when operating a front-end loader.
9. State suggestions for effective loader operations.
10. Select from a list items to check on a daily inspection.
11. Select from a list items to check when servicing a front-end loader.
12. List materials needed to service a front-end loader.
13. Demonstrate the ability to
    a. Perform starting procedures.
    b. Perform digging operations.
    c. Perform loading operations.
    d. Perform bulldozing operations.
    e. Perform demolition operations.
    f. Excavate a basement.

FRONT-END LOADERS
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Provide students with objective sheet.
- B. Provide students with information, assignment, and job sheets.
- C. Discuss unit and specific objectives.
- D. Discuss information and assignment sheets.
- E. Stress to students that manipulation of controls and operating procedures may vary with different types and manufacturers of equipment.
- F. Demonstrate and discuss procedures outlined in job sheets.
- G. Provide alternative jobs if job sheets are not practical.
- H. Give test.

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Assignment Sheet #1--List Materials Needed to Service a Front-End Loader
- E. Answers to assignment sheet
- F. Job sheets
  - 1. Job Sheet #1--Perform Starting Procedures
  - 2. Job Sheet #2--Perform Digging Operations
  - 3. Job Sheet #3--Perform Loading Operations
  - 4. Job Sheet #4--Perform Bulldozing Operations
  - 5. Job Sheet #5--Perform Demolition Operations
  - 6. Job Sheet #6--Excavate a Basement
- G. Test
- H. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. Nichols, Herbert L., Jr. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

B. *1150C Crawler, Operator's Manual 9-6451.* Racine, Wisconsin: JI Case, Construction Equipment Division, 1978.

C. *W20 Articulated Loaders Operator's Manual 9-4862.* Racine, Wisconsin: JI Case, Construction Equipment Division, 1975.

FRONT-END LOADERS
UNIT IV

INFORMATION SHEET

I. Uses of front-end loaders (Figures 1 and 2)

   A. Loading

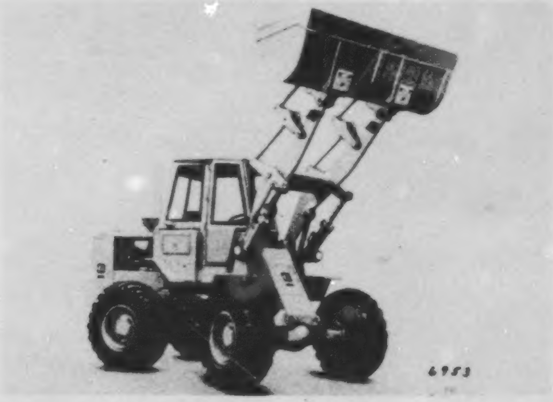
   B. Digging

   C. Rough grading

   D. Hauling

   E. Fine grading

FIGURE 1



Wheel-type loader

FIGURE 2

Crawler-type loader

INFORMATION SHEET

II. Terms and definitions

- A. Articulated--Jointed
- B. Ram--Hydraulic cylinder
- C. Accessories--Attachments used to increase the effectiveness of a machine's use
- D. Stockpile--Earth put into a pile and saved for future use
- E. Cycle--To repeat; to go over previous steps again
- F. Fill--Raising elevation of the ground to desired level
- G. Debris--Rough broken bits of materials such as stone, wood, glass, rubbish, and litter after destruction
- H. Rubble--Fragments of stone, bricks, and rock broken from larger bodies

III. Types of front-end loaders

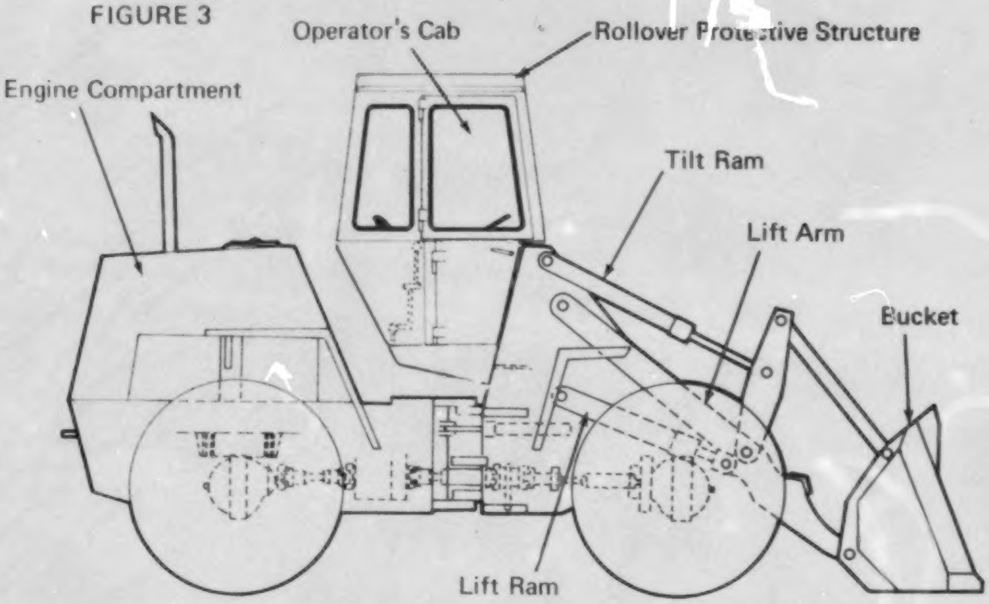
- A. Rigid frame wheel
- B. Articulated wheel
- C. Crawler
- D. Tractor
- E. Skid steer (utility)

INFORMATION SHEET

IV. Parts of loaders (Figures 3 and 4)

A. Wheel-type loader

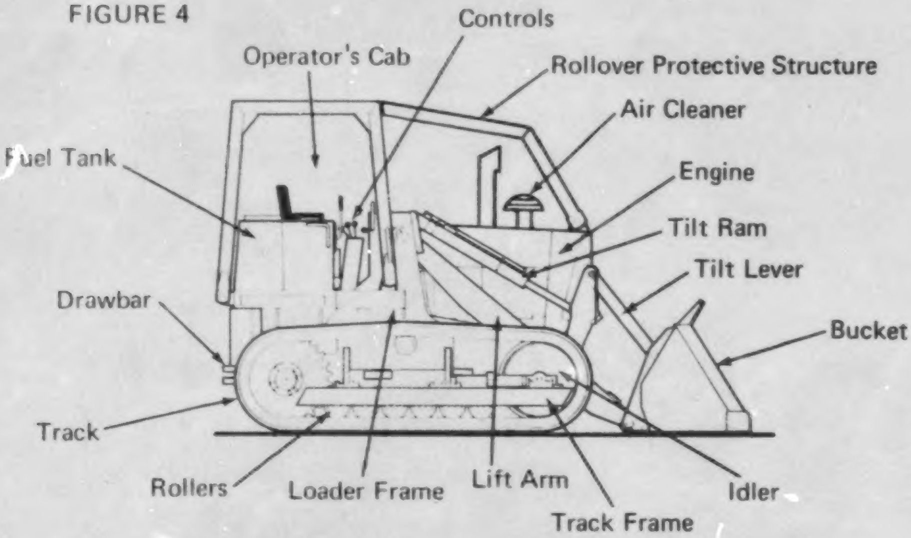
FIGURE 3


Operator's Cab
Rollover Protective Structure
Engine Compartment
Tilt Ram
Lift Arm
Bucket
Lift Ram

Used with permission of JI Case, a Tenneco Company.

B. Crawler-type loader

FIGURE 4

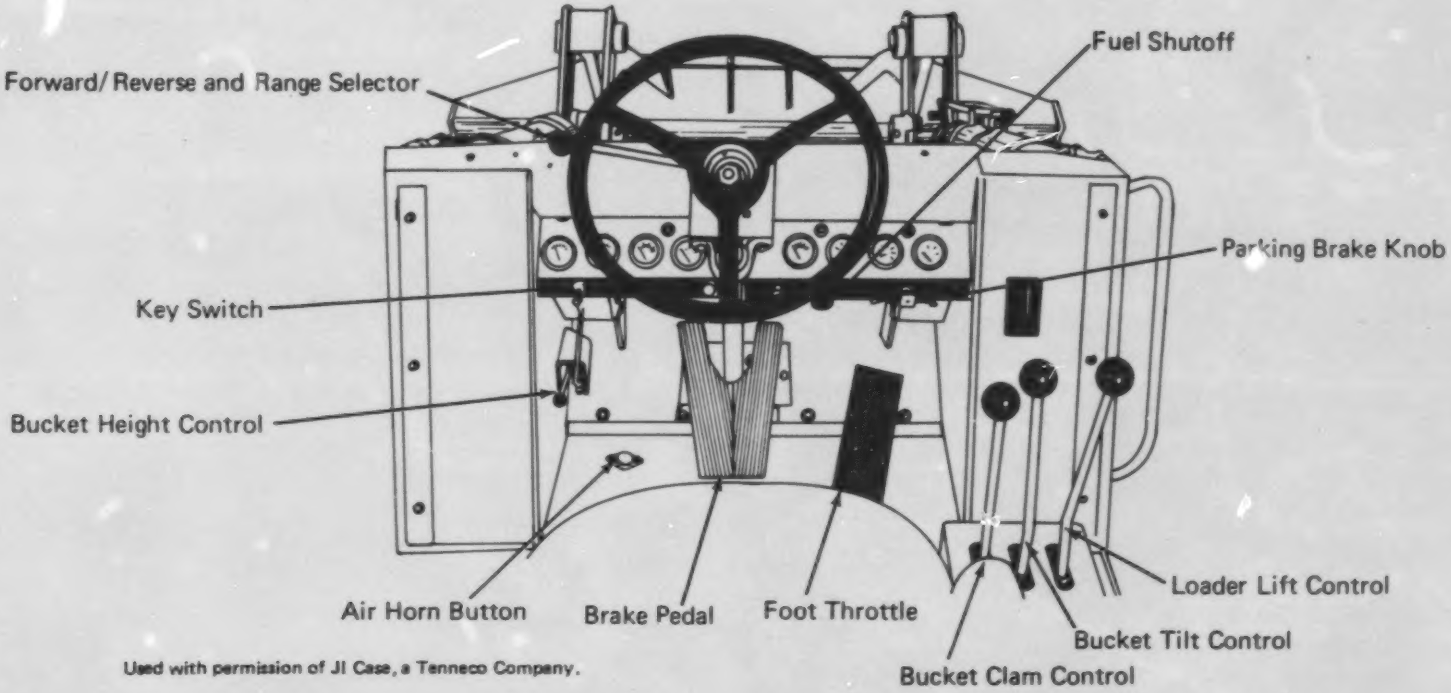

Controls
Operator's Cab
Rollover Protective Structure
Air Cleaner
Fuel Tank
Engine
Tilt Ram
Tilt Lever
Drawbar
Bucket
Track
Rollers
Loader Frame
Lift Arm
Idler
Track Frame

Used with permission of JI Case, a Tenneco Company.

INFORMATION SHEET

V. Controls for a typical wheel-type front end loader (Figure 5)

FIGURE 5


Forward/ Reverse and Range Selector
Fuel Shutoff
Parking Brake Knob
Key Switch
Bucket Height Control
Air Horn Button
Brake Pedal
Foot Throttle
Loader Lift Control
Bucket Tilt Control
Bucket Clam Control

Used with permission of JI Case, a Tenneco Company.

INFORMATION SHEET

VI. Accessories used on front-end loaders

- A. Bucket
- B. Dozer blade
- C. Slat loader bucket
- D. Side dump bucket
- E. Demolition bucket
- F. Ejector bucket
- G. Overhead shovel
- H. Rocker shovel
- I. Four-in-one bucket

VII. Types of jobs done with loaders

- A. Load trucks
- B. Stockpile
- C. Rough grade
- D. Dig banks
- E. Haul materials and equipment
- F. Load and carry
- G. Demolition
- H. Excavate
- I. Backfill
- J. Finish grade

VIII. Safety procedures to use when operating a front-end loader

- A. Be sure everyone is clear of equipment before starting
- B. Never allow riders on any part of machine
- C. Be extremely careful when operating near banks and slopes
- D. Always operate at a safe speed
- E. Travel with bucket low to the ground

INFORMATION SHEET

F. Always lower bucket to ground before performing any service or when leaving loader unattended

G. Always turn engine off and secure controls before leaving machine

H. Use seat belt at all times

I. Use a rigid-type coupler when towing

J. Know and follow hand signals given by signal person

K. Wear proper safety equipment

L. Never jump from machine; always mount and dismount using steps and grab irons

IX. Suggestions for effective loader operations

(NOTE: The following are helpful suggestions for improving operating efficiency.)

A. Before starting job operations, calculate and plan how you are going to complete the job

B. Do not move the machine until brake air system reaches 65 psi

C. Set up work cycle so it will be as short as possible

D. Spot trucks properly

E. Level off work area if necessary

F. Keep transport distances as short as possible

G. Keep transmission range lever in low range during loading operations and when transporting load

H. Keep the wind to your back when dumping into a truck

I. Keep equipment clean

J. Service equipment regularly to ensure efficient operation

X. Items to check on a daily inspection

(NOTE: Deficiencies should be noted on a pad.)

A. Visual inspection for broken, worn, or missing parts, and leaks

B. Engine oil level

C. Engine coolant level

D. Fuel level

INFORMATION SHEET

E. Hydraulic reservoir level

F. Battery electrolyte level

G. Air cleaner

H. Brakes

I. Tires or tracks

J. Transmission

K. Exhaust system

L. Wire connections and insulation

M. Drive belts

N. Major components and accessories

O. Cleanliness of equipment

P. Windshield and wipers (when applicable)

Q. Gauges, for normal operation

R. Controls, for proper functioning

S. Safety devices

XI. Items to check when servicing a front-end loader (Assignment Sheet #1)

A. Engine oil and filter

B. Air cleaner inlet screen

C. Air filter

D. Engine coolant level; fill if necessary

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Fuel level; fill if necessary

F. Fuel filter

G. Sediment bowl (if applicable)

H. Battery electrolyte level, cables and connectors

(NOTE: Keep sparks and fire away from battery.)

INFORMATION SHEET

I. Hydraulic reservoir; fill if required

J. Transmission pressure line filter

K. Transmission fluid; fill if necessary

L. Transmission breather

M. Oil level in each final drive housing

N. Tires and tracks

O. Grease fittings

P. Brakes; adjust if required

Q. Windshield and wipers (where applicable)

R. Drive belts; adjust and/or replace if necessary

S. Major components and accessories

T. Track drive links and pads; clean and check tightness if necessary

U. Safety devices

V. Gauges and controls for proper functioning

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

FRONT-END LOADERS
UNIT IV

ASSIGNMENT SHEET #1–LIST MATERIALS NEEDED TO SERVICE A FRONT-END LOADER

NAME ______________________ SCORE __________

Using the Information Sheet in this unit, list materials needed to service a front-end loader.

A. ______________________

B. ______________________

C. ______________________

D. ______________________

E. ______________________

F. ______________________

G. ______________________

H. ______________________

I. ______________________

J. ______________________

K. ______________________

FRONT-END LOADERS
UNIT IV

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

(NOTE: Types of lubrication will vary due to the different manufacturers and types of equipment. This lesson must be evaluated to the satisfaction of the instructor because of this.)

A. Tool kit, engine oil, and new parts where needed

B. Cleaning solvent

C. Engine coolant

D. Gasoline or diesel fuel

E. Baking soda, anti-corrosion paste, and water or electrolyte

F. Hydraulic fluid

G. Transmission fluid

H. Oil for final drive housing

I. Air supply

J. Lubricating grease

K. Brake fluid

FRONT-END LOADERS
UNIT IV

JOB SHEET #1--PERFORM STARTING PROCEDURES

I. Equipment--Front-end loader

II. Procedure

A. Be sure all controls are in neutral

B. Engage parking brake lever to set brake

C. Shift gears to neutral position

D. Place ignition switch in "on" position

E. Press accelerator level down 1/3 total distance

F. Press starter button

(CAUTION: Never operate starter more than 30 seconds at a time. If engine fails to start, wait 2 to 5 minutes before cranking again.)

G. Warm up engine for 5 minutes

H. Determine that all gauges and instruments are functioning properly

I. Shift gears to low range

J. Release brake

K. Check all controls for proper operation

L. Check service brakes for operation

M. Check steering for proper operation

N. Manipulate controls to be sure all components are operating properly

O. Shift gears to neutral and lock

P. Reset brake

Q. Make final visual check for leaks, unusual noises, or abnormal vibrations

FRONT-END LOADERS
UNIT IV

JOB SHEET #2--PERFORM DIGGING OPERATIONS

I. Equipment--Front-end loader with bucket

II. Procedure

A. Raise bucket 12 to 18 inches above ground (travel position)

B. Pull bucket control lever to tilt bucket

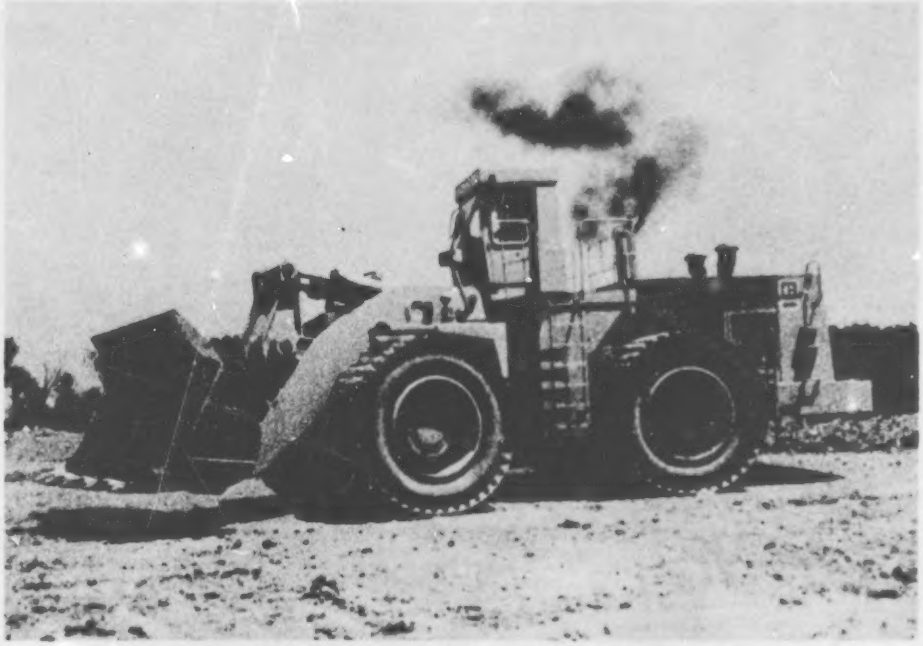
C. Release hand brake

D. Shift to appropriate gear

(NOTE: Preset throttle for track loader.)

E. Press accelerator pedal down, and proceed to job site (Figure 6)

FIGURE 6



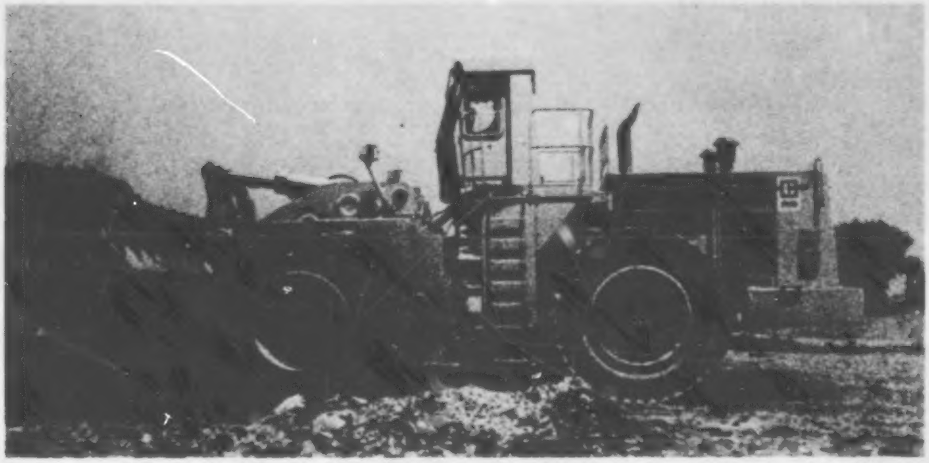
F. Move bucket control lever to scoop position

JOB SHEET #2

G. Lower bucket to ground and move forward (Figure 7)

(CAUTION: Never spin wheels or tracks.)

FIGURE 7



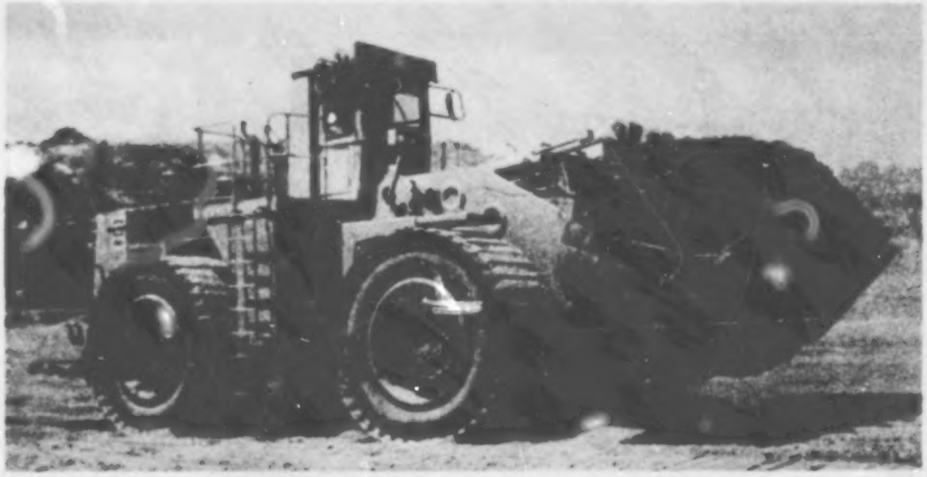
H. Manipulate bucket until it is loaded

I. Place bucket and boom control levers on "hold" when bucket is filled

J. Shift gears to reverse and back loader

K. Position bucket in travel position (12 to 18 inches above ground), and proceed to dumping area (Figure 8)

FIGURE 8



JOB SHEET #2

L. Move bucket control lever forward to dump bucket, and at same time pull boom control lever to rear to retract bucket

M. Pull bucket control lever to retract empty bucket, and at same time back loader away from pile

N. Position bucket in travel position, and return to excavation

O. Repeat cycle until excavation is completed

FRONT-END LOADERS
UNIT IV

JOB SHEET #3--PERFORM LOADING OPERATIONS

I. Equipment and material

   A. Front-end loader with bucket

   B. Dump truck

   C. Stockpile

II. Procedure

   A. Raise bucket to travel position (12 to 18 inches above ground)

   B. Pull bucket control lever to tilt bucket

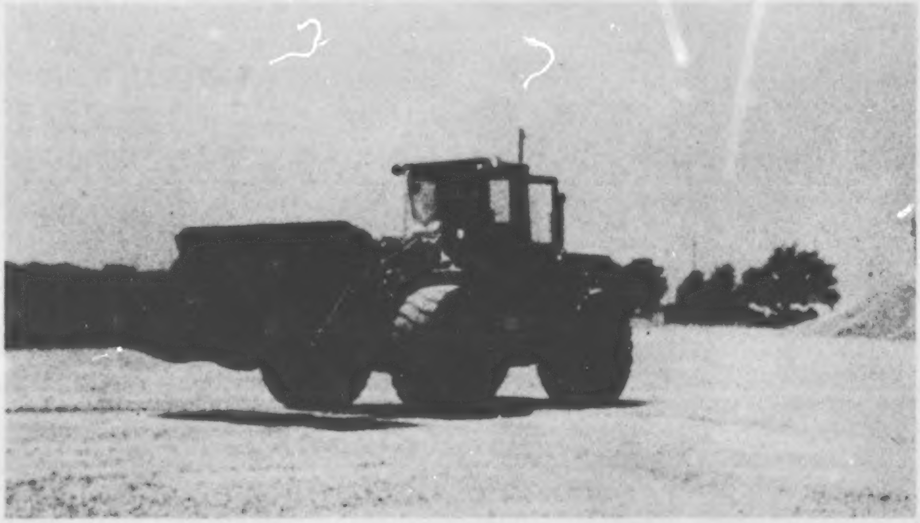
   C. Release hand brake

   D. Shift to appropriate gear

   (NOTE: Preset throttle for track loader.)

   E. Press accelerator pedal down, and proceed to job site (Figure 9)

FIGURE 9

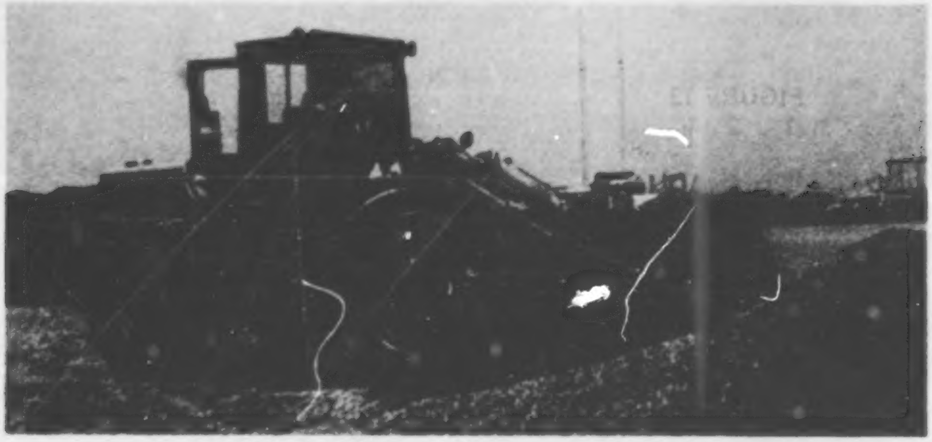


   F. Manipulate control levers for appropriate bucket position

JOB SHEET #3

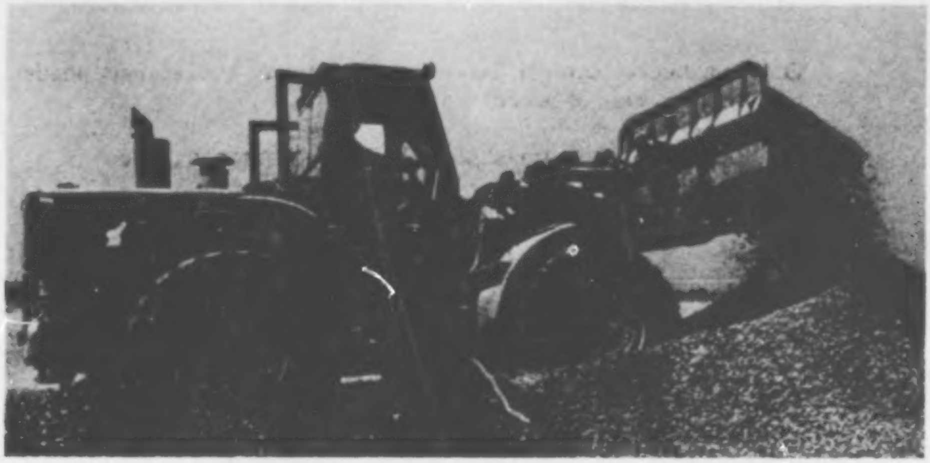
G. Drive loader into stockpile (Figure 10)

FIGURE 10



H. Adjust controls and brake pedal as required to fill bucket (Figure 11)

FIGURE 11



I. Place bucket and boom control levers on "hold" when bucket is filled

J. Shift gears to reverse

K. Back loader away from stockpile

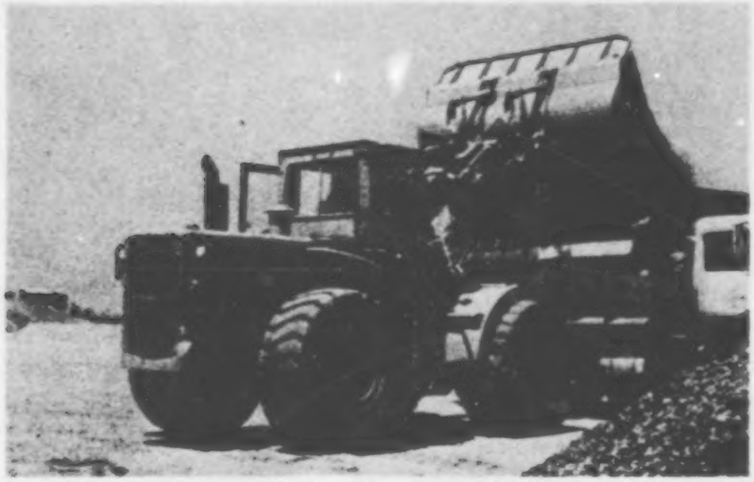
L. Position bucket in travel position (12 to 18 inches above ground), and move loader to truck

JOB SHEET #3

M. Center loader with truck bed, and raise bucket to clear side of truck

N. Move bucket over truck bed; move bucket control lever forward to dump bucket, and at same time pull boom control lever to rear to retract bucket (Figure 12)

FIGURE 12



O. Pull bucket control lever to retract empty bucket; back loader away from truck as soon as bucket is empty

P. Lower bucket to travel position, and return to stockpile

Q. Repeat cycle until truck is loaded

FRONT-END LOADERS
UNIT IV

JOB SHEET #5--PERFORM DEMOLITION OPERATIONS

I. Equipment

A. Track or wheel loader

B. Dump truck with F.O.P.S. (falling object protective structure)

II. Procedure

A. Mount machine using steps and grab irons

B. Sit in operator's seat and secure seat belt

C. Release parking brake and transmission lock

D. Raise bowl to clear ground

E. Select travel speed and move to building site

F. Downshift into first gear and raise boom to an overhead position

G. Approach building cautiously and place bucket on building wall

H. Very slowly move forward to push top of wall in

I. As building begins to fall, select reverse gear and back away

J. Continue placing bucket on wall until all of building is down

K. Load bucket and approach dump area

L. Raise bucket to clear side of truck

M. Dump material slowly to avoid jarring or damaging truck

N. Continue loading until all debris is removed from site

O. Slide edge under floor and lift

(NOTE: If floor has a footing, you may have to excavate until you can slide under footing.)

P. Lift until floor breaks (wood) or section is high enough to drop and break

Q. Load bucket with rubble and load in truck

(NOTE: Large pieces should be placed on the top of loads to avoid hanging up in the truck.)

R. Continue until all rubble is cleared from site

FRONT-END LOADERS
UNIT IV

JOB SHEET #6–EXCAVATE A BASEMENT

I. Equipment

A. Track loader

B. Area staked with stringline set

II. Procedure

A. Raise bucket to travel position (12 to 18 inches above ground)

B. Release brake and transmission locks

C. Set throttle to desired engine speed

D. Shift to appropriate gear

E. Travel to job site

F. Align loader bucket edge approximately 12 inches inside stringlines

G. Lower bucket to ground, making sure the loader is well back from excavation; tilt cutting edge down to load bucket

H. Retract bucket when machine begins to stall

I. Raise boom control and continue to complete loading bucket

J. Place bucket and boom control levers on "hold" when bucket is full

K. Back loader up ramp, and travel to dump area

L. Raise boom, and dump bucket

M. Lower boom to travel position, and travel back to excavation

N. Repeat cycle until proper depth is reached

O. Lower boom and bucket to proper cutting angle

P. Begin cutting a level bench

Q. Continue cycle until area inside stringline is completely excavated to proper depth

FRONT-END LOADERS
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. List uses of front-end loaders.

a. ____

b. ____

c. ____

d. ____

e. ____

2. Match terms associated with front-end loaders to their correct definitions. Write the correct numbers in the blanks.

______a. Jointed

______b. Hydraulic cylinder

______c. Attachments used to increase the effectiveness of a machine's use

______d. Earth put into a pile and saved for future use

______e. To repeat; to go over previous steps again

______f. Raising elevation of the ground to desired level

______g. Fragments of stone, brick, and rock broken from larger bodies

______h. Rough broken bits of materials such as stone, wood, glass, rubbish, and litter after destruction

1. Fill
2. Stockpile
3. Articulated
4. Ram
5. Cycle
6. Accessories
7. Debris
8. Rubble

3. List types of front-end loaders.

a. ____

b. ____

c. ____

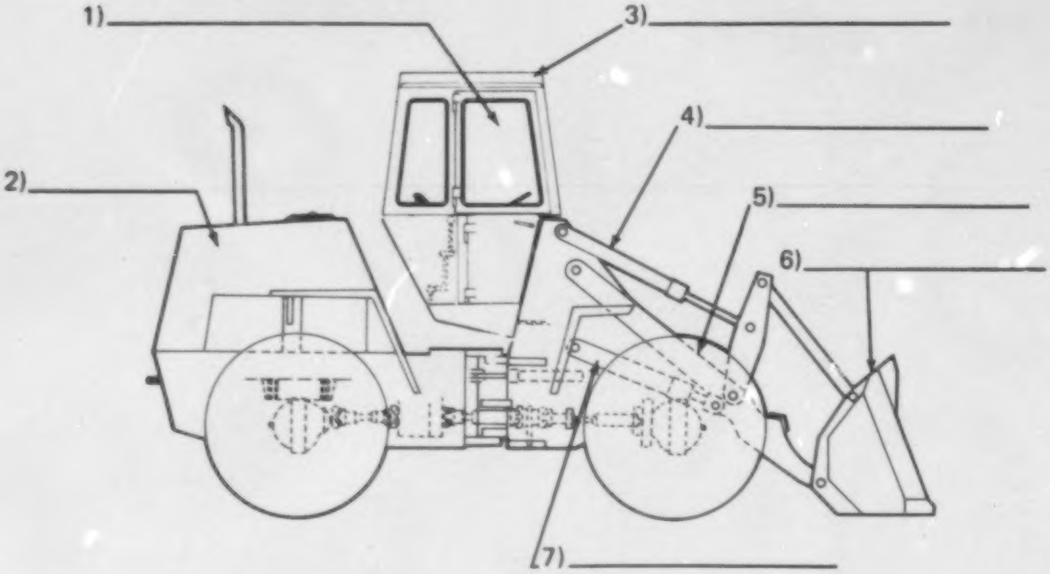
d. ____

e. ____

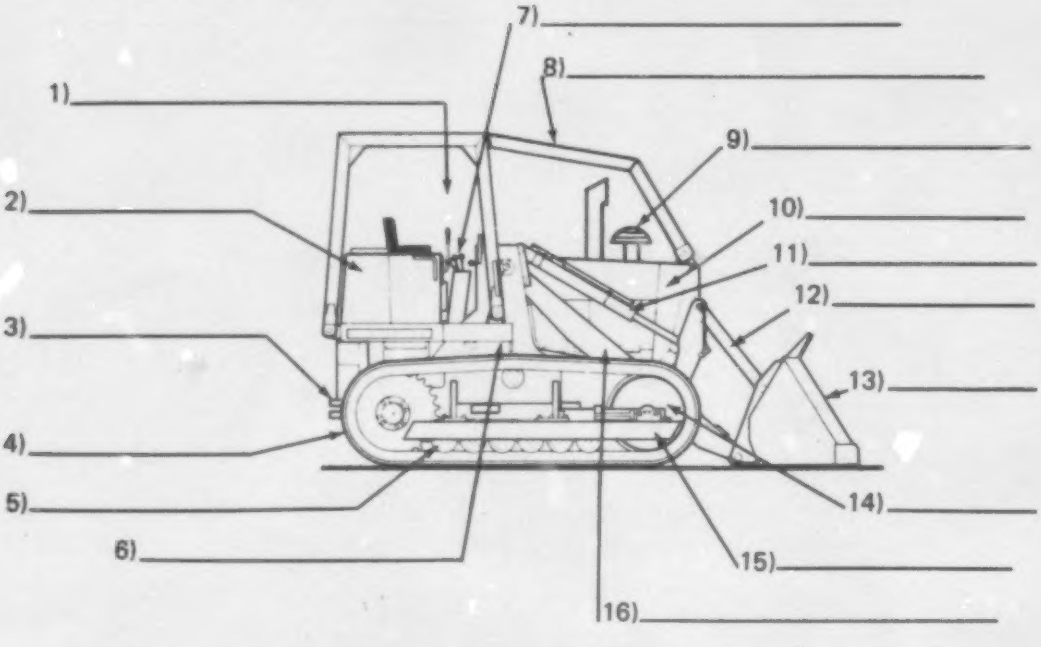
TEST

4. Label parts of the loaders illustrated below. Write the correct names in the blanks.

   a. Wheel-type loader



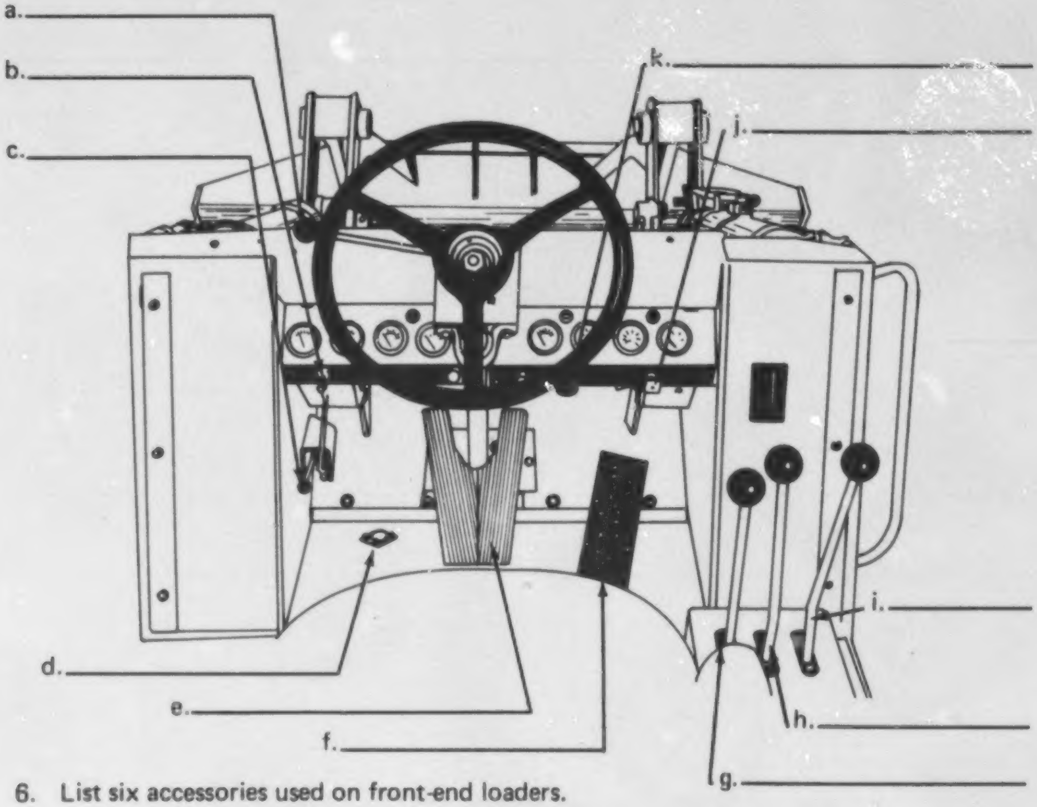
   b. Crawler-type loader


1)
2)
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)
13)
14)
15)
16)

TEST

5. Identify controls for a typical wheel-type front-end loader illustrated below. Write the correct terms in the blanks provided.

Forward/reverse and range selector
Key switch
Bucket height control
Air horn button
Brake pedal
Foot throttle
Fuel shut-off
Parking brake knob
Loader lift control
Bucket tilt control
Bucket clam control



6. List six accessories used on front-end loaders.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

TEST

7. List eight types of jobs done with loaders.

a. ____________________
b. ____________________
c. ____________________
d. ____________________
e. ____________________
f. ____________________
g. ____________________
h. ____________________

8. List eight safety procedures to use when operating a front-end loader.

a. ____________________
b. ____________________
c. ____________________
d. ____________________
e. ____________________
f. ____________________
g. ____________________
h. ____________________

9. State eight suggestions for effective loader operations.

a. ____________________
b. ____________________
c. ____________________
d. ____________________
e. ____________________
f. ____________________
g. ____________________
h. ____________________

TEST

10. Select from the following list items to check on a daily inspection. Write an "X" in the blank before each correct answer.

______a. Exhaust system

______b. Hydraulic reservoir level

______c. Air cleaner

______d. Thermostat

______e. Tires or tracks

______f. Differential gears

______g. Drawbar

______h. Drive belts

______i. Brakes

______j. Transmission

______k. Gauges, for normal operation

______l. Major components and accessories

______m. Bucket height

______n. Light beams

______o. Controls, for proper functioning

______p. Cleanliness of equipment

11. Select from the following list items to check when servicing a front-end loader. Write an "X" in the blank before each correct answer.

______a. Battery plates

______b. Engine coolant type

______c. Transmission pressure plates

______d. Track drive links and pads; clean and check tightness if necessary

______e. Tires and tracks

______f. Air cleaner inlet screen

______g. Exhaust system heat

TEST

_____h. Transmission breather

_____i. Fuel filter

_____j. Water tank

_____k. Air filter

_____l. Fuel injector level; fill if needed

_____m. Air in blower at turbocharger

_____n. Fuel consumption

_____o. Engine oil and filter

_____p. Engine compression

_____q. Grease fittings

_____r. Safety devices

(NOTE: Test questions 12 and 13 are assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

12. List materials needed to service a front-end loader.

13. Demonstrate the ability to

    a. Perform starting procedures.

    b. Perform digging operations.

    c. Perform loading operations.

    d. Perform bulldozing operations.

    e. Perform demolition operations.

    f. Excavate a basement.

FRONT-END LOADERS
UNIT IV

ANSWERS TO TEST

1. a. Loading
   b. Digging
   c. Rough grading
   d. Hauling
   e. Fine grading

2. a. 3 d. 2 g. 8
   b. 4 e. 5 h. 7
   c. 6 f. 1

3. a. Rigid frame wheel
   b. Articulated wheel
   c. Crawler
   d. Tractor
   e. Skid steer (utility)

4. a. Wheel-type loader
      1) Operator's cab
      2) Engine compartment
      3) Rollover protective structure
      4) Tilt ram
      5) Lift arm
      6) Bucket
      7) Lift ram
   b. Crawler-type loader
      1) Operator's cab
      2) Fuel tank
      3) Drawbar
      4) Track
      5) Rollers

ANSWERS TO TEST

6) Loader frame
7) Controls
8) Rollover protective structure
9) Air cleaner
10) Engine
11) Tilt ram
12) Tilt lever
13) Bucket
14) Idler
15) Track frame
16) Lift arm

5. a. Forward/reverse and range selector
   b. Key switch
   c. Bucket height control
   d. Air horn button
   e. Brake pedal
   f. Foot throttle
   g. Bucket clam control
   h. Bucket tilt control
   i. Loader lift control
   j. Parking brake knob
   k. Fuel shutoff

6. Answer should include any six of the following
   a. Bucket
   b. Dozer blade
   c. Slat loader bucket
   d. Side dump bucket

ANSWERS TO TEST

   e. Demolition bucket
   f. Ejector bucket
   g. Overhead shovel
   h. Rocker shovel
   i. Four-in-one bucket

7. Answer should include any eight of the following
   a. Load trucks
   b. Stockpile
   c. Rough grade
   d. Dig banks
   e. Haul materials and equipment
   f. Load and carry
   g. Demolition
   h. Excavate
   i. Backfill
   j. Finish grade

8. Answer should include any eight of the following
   a. Be sure everyone is clear of equipment before starting
   b. Never allow riders on any part of machine
   c. Be extremely careful when operating near banks and slopes
   d. Always operate at a safe speed
   e. Travel with bucket low to the ground
   f. Always lower bucket to ground before performing any service or when leaving loader unattended
   g. Always turn engine off and secure controls before leaving machine
   h. Use seat belt at all times

ANSWERS TO TEST

    i. Use a rigid-type coupler when towing
    j. Know and follow hand signals given by signal person
    k. Wear proper safety equipment
    l. Never jump from machine; always mount and dismount using steps and grab irons

9. Any eight of the following
    a. Before starting job operations, calculate and plan how you are going to complete the job
    b. Do not move the machine until brake air system reaches 65 psi
    c. Set up work cycle so that it will be as short as possible
    d. Spot trucks properly
    e. Level off work area if necessary
    f. Keep transport distances as short as possible
    g. Keep transmission range lever in low range during loading operations and when transporting load
    h. Keep the wind to your back when dumping into a truck
    i. Keep equipment clean
    j. Service equipment regularly to ensure efficient operation

10. a, b, c, e, h, i, j, k, l, o, p

11. d, e, f, h, i, k, o, q, r

12. Evaluated to the satisfaction of the instructor

13. Performance skills evaluated to the satisfaction of the instructor

GRADERS
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a grader to perform various jobs. This knowledge will be shown by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of graders.
2. Match terms associated with graders to their correct definitions.
3. Label basic parts of a grader.
4. Identify controls on a typical grader.
5. List accessories used on graders.
6. Select from a list types of jobs done with graders.
7. State suggestions for effective grader operations.
8. List safety precautions to observe while operating a grader.
9. List items to check on a daily inspection.
10. Select from a list items to check after warm-up.
11. Demonstrate the ability to
    - a. Service a grader.
    - b. Make a windrow.
    - c. Cut a firebreak.
    - d. Remove snow.
    - e. Blend and spread material on a roadbed.
    - f. Perform V-type ditch construction.

GRADERS
UNIT V

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order films and other materials planned to supplement unit.

      (NOTE: Most equipment manufacturers are good sources for films on specific pieces of equipment.)

      1. *Moving the Earth*. Engineering Extension Service, Texas A & M University, College Station, Texas.

      2. *Fundamentals of Earthmoving*. Color, 18 min., Caterpillar Tractor Company, 1967. Available from Advertising Division of Caterpillar Tractor Company, 100 N.E. Adams Street, Peoria, Illinois 61602.

      3. *The Last Mile*. Available from Advertising Division of Caterpillar Tractor Company, 100 N.E. Adams Street, Peoria, Illinois 61602.

   B. Provide students with objective sheet.

   C. Provide students with information and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Stress to students that manipulation of controls and operating procedures may differ with different models and manufacturers.

   G. Demonstrate and discuss procedures outlined in job sheets.

   H. Provide alternative jobs if job sheets are not practical.

   I. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Service a Grader

      2. Job Sheet #2--Make a Windrow

      3. Job Sheet #3--Cut a Firebreak

SUGGESTED ACTIVITIES

4. Job Sheet #4--Remove Snow
5. Job Sheet #5--Blend and Spread Material on a Roadbed
6. Job Sheet #6--Perform V-type Ditch Construction

E. Test

F. Answers to test

III. Unit references

A. *Galion Operator's Manual No. 3950R1: Model A550 Motor Grader*. Galion, Ohio: Gailion Manufacturing Division, Dresser Industries, Inc., n.d.

B. *Motor Grader Manual: Equipment Operator Training.* Washington State Department of Transportation, n.d.

C. Nichols, H. L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

D. *Teacher's Guide: Heavy Equipment Operator Training, Unit II, Motor Grader Operation.* College Station, Texas: Engineering Extension Service, Texas A & M University, n.d.

GRADERS
UNIT V

INFORMATION SHEET

I. Uses of graders (Figure 1)

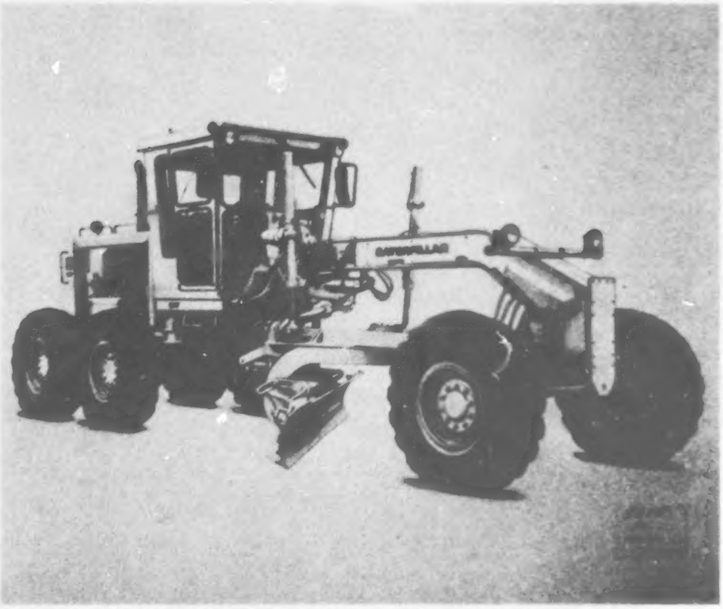
   A. Cutting

   B. Shaping

   C. Earth moving

   D. Fine grading

FIGURE 1



Courtesy of Caterpillar Tractor Company.

II. Terms and definitions

   A. Articulated--Jointed

   B. Accessories--Attachments used to increase the effectiveness of a machine's use

   C. Top off--Fill

   D. Scarify--Shallow loosening of road surface

   E. Windrow--Ridge of loose dirt

INFORMATION SHEET

F. Blue tops--Hub stakes used during final grading process when existing grade is within 0.2' of desired grade (marked with blue keel)

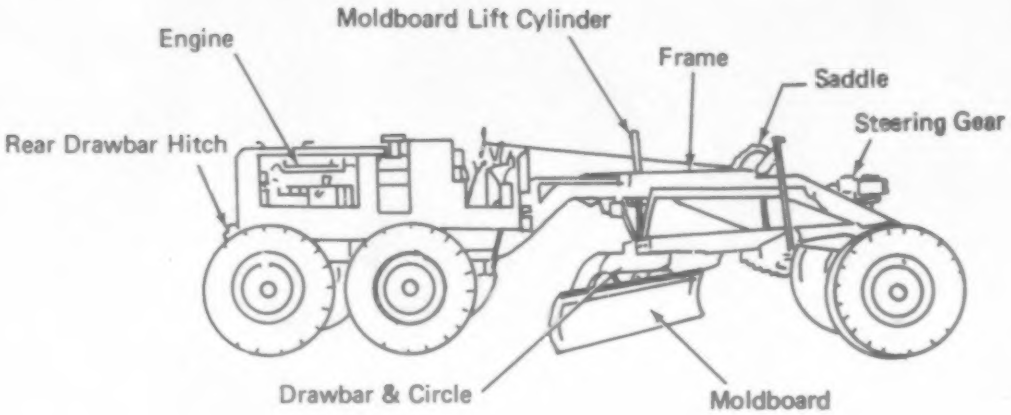
G. Blend--To mix materials until they are uniform

H. Fire break--Area cleared of combustible materials

I. Keel--Colored marking crayon used to mark tops of blue-top stakes

III. Basic parts of a grader (Figure 2)

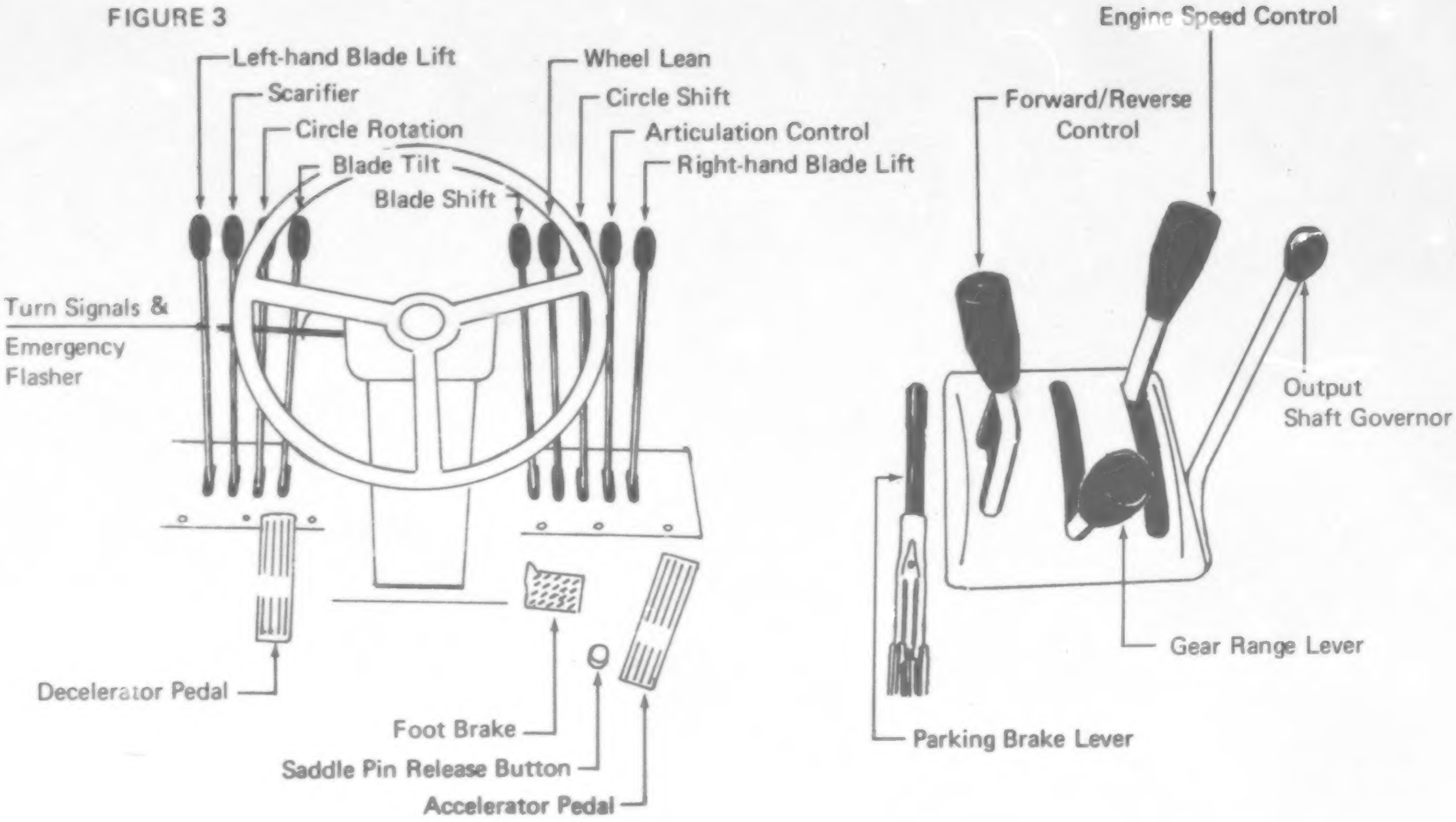
FIGURE 2


Moldboard Lift Cylinder
Engine
Frame
Saddle
Steering Gear
Rear Drawbar Hitch
Drawbar & Circle
Moldboard

INFORMATION SHEET

IV. Controls on a typical grader (Figure 3)

FIGURE 3


Left-hand Blade Lift
Scarifier
Circle Rotation
Blade Tilt
Blade Shift
Wheel Lean
Circle Shift
Articulation Control
Right-hand Blade Lift
Engine Speed Control
Forward/Reverse Control
Turn Signals & Emergency Flasher
Output Shaft Governor
Gear Range Lever
Decelerator Pedal
Foot Brake
Saddle Pin Release Button
Accelerator Pedal
Parking Brake Lever

Used with permission of Galion Manufacturing Division, Dresser Industries, Inc.

INFORMATION SHEET

V. Accessories used on graders

- A. Snowplow
- B. Side wing
- C. Bank sloper
- D. Scarifier
- E. Ripper
- F. Rake blade
- G. Belt loader
- H. Arm-mounted clearing tool
- I. Dozer blade
- J. Trailer drag
- K. Disc harrow
- L. Laser power and/or sensor

VI. Types of jobs done with graders

- A. Leveling
- B. Ripping
- C. Scarifying
- D. V-type ditch construction
- E. Bank sloping
- F. Flat bottom ditch cutting
- G. Reverse blading
- H. Mixing and spreading materials
- I. Snow removal
- J. Finish grading
- K. Road maintenance

INFORMATION SHEET

VII. Suggestions for effective grader operations

- A. Do not work machine over capacity
- B. Travel at highest practical travel speed
- C. Use extreme care when turning on a downgrade
- D. Service equipment regularly to ensure efficient operation
- E. Keep equipment clean
- F. Set up work cycle so it will be as short as possible
- G. Calculate and plan operations before starting
- H. Protect grader from dust and sand as much as possible
- I. When front end tends to veer out of line, lean wheels in opposite direction enough to correct and hold machine in line; when rear module veers, move it in opposite direction enough to correct and hold machine in line
- J. Always use decelerator or throttle to slow engine speed when shifting
- K. Avoid excessive speed, particularly on rough ground

VIII. Safety precautions to observe while operating a grader

- A. Wear safety items required by job conditions
- B. Know and observe hand signals
- C. Be sure all safety guards and covers are secured and in place
- D. Do not back machine until you are sure personnel and obstructions are clear
- E. Check all safety devices before moving machine
- F. Do not jump on or off machine
- G. Do not allow anyone to ride on machine
- H. Know traffic pattern of job and obey signal person
- I. Always park on level ground, if possible
- J. Apply down pressure on blade and block wheels, if necessary, to park on a grade
- K. Do not leave machine's engine running unattended
- L. Avoid operating too close to banks or overhangs

INFORMATION SHEET

IX. Items to check on a daily inspection

(NOTE: Deficiencies should be noted on a pad.)

A. Visual inspection for broken, worn, or missing parts and leaks

B. Engine oil level

C. Engine coolant level

D. Fuel level

E. Hydraulic reservoir level

F. Battery electrolyte level, cables, and connectors

G. Tire pressure and condition

H. Air cleaner

I. Drive belts

J. Wire connections and insulation

K. Moldboards, cutting edges, end boots, and scarifier

L. Windshield and wipers (when applicable)

M. Brakes and brake fluid

N. Cleanliness of equipment

O. Exhaust system

P. Safety devices

Q. Gauges and controls for proper functioning

R. Major components

X. Items to check after warm-up

A. All gauges, for proper pressures and temperatures

B. Equipment, for unusual noise or vibration

C. Performance of components, by operating controls

(NOTE: Make final visual inspection.)

GRADERS
UNIT V

JOB SHEET #1--SERVICE A GRADER

I. Equipment and materials

- A. Operator's service manual
- B. Checklist
- C. Tool kit
- D. Lube spout
- E. Small brush and rags
- F. Grease gun
- G. Tire gauge and air supply
- H. Tension gauge or rule
- I. Radiator hydrometer
- J. Engine oil
- K. Engine coolant
- L. Fuel
- M. Hydraulic fluid
- N. Water, electrolyte, and battery hydrometer
- O. Cleaning solvent
- P. Brake fluid
- Q. Grease
- R. Transmission fluid
- S. Open gear lubricant
- T. Shop rags

II. Procedure

(NOTE: Follow manufacturer's recommendations when servicing equipment.)

- A. Repair or replace any worn, broken, or missing items
- B. Check engine oil dipstick; change or add oil if necessary

JOB SHEET #1

C. Check engine coolant; add coolant if necessary

D. Top off fuel tank

E. Check hydraulic fluid reservoir; fill if required

F. Check battery connections and electrolyte level; fill if required

G. Check tire pressure; inflate to recommended pressure

H. Check condition of tires

I. Remove, clean, and service air cleaners; replace filter if necessary

J. Check brake master cylinder; add fluid if required

K. Check brakes; adjust if necessary

L. Check wire connections and insulation; repair or replace if necessary

M. Check condition and adjustment of drive belts; adjust or replace if necessary

N. Check all components; adjust if required

O. Clean and grease all grease fittings according to manufacturer's recommendations

P. Check and lubricate circle

GRADERS
UNIT V

JOB SHEET #2--MAKE A WINDROW

I. Equipment--Grader

II. Procedure

- A. Mount machine, using steps and grab irons
- B. Sit in operator's seat and secure seat belt
- C. Raise blade off ground approximately 20"
- D. Release parking brake and transmission lock
- E. Select first forward gear and move to area to be graded
- F. Circle to the left to position toe of blade behind right front tire
- G. To avoid driving over windrow, slide blade shift so that heel is clear of left tandem drive wheel (Figure 4)

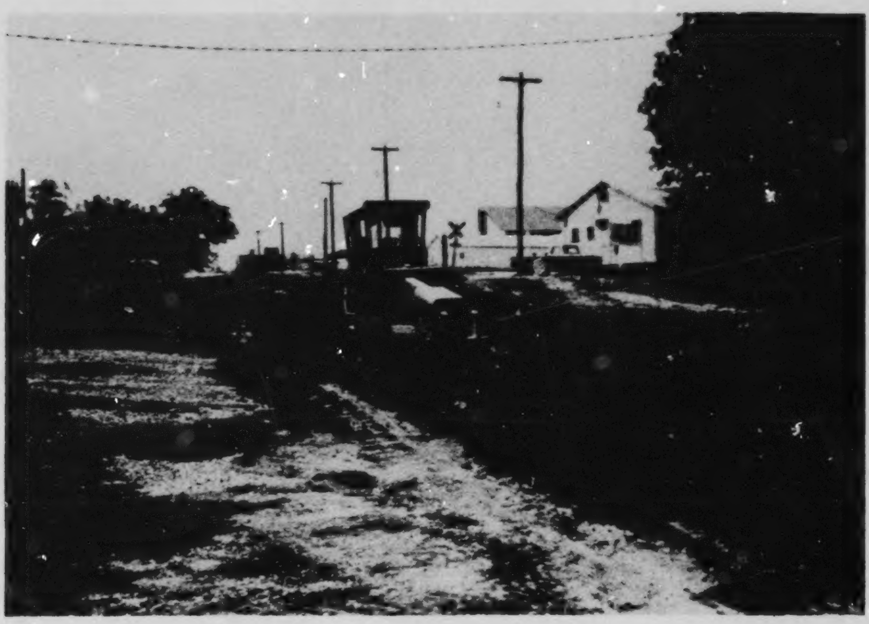
FIGURE 4

JOB SHEET #2

H. Lower toe and heel of blade to begin cutting material

(NOTE: As desired depth is reached, material on the front of the blade should flow freely to heel of blade, and form the windrow; see Figure 5.)

FIGURE 5



I. Continue making windrow until reaching the end of cut

J. Raise blade clear of ground and stop

K. Select reverse and back up, observing what is behind the machine, until returned to starting point

L. Stop and shift to first forward gear

M. Move machine to the left to position right front tire to the left of previous windrow

N. Lower blade to ground to make a light grading pass; observe material flowing to left heel of blade

O. As windrow becomes larger, the grader's front tires should lean toward windrow to counteract sidedraft of grade

P. Continue process until windrow is desired size

GRADERS
UNIT V

JOB SHEET #3--CUT A FIREBREAK

I. Equipment--Heavy grader

II. Procedure

- A. Mount grader using steps and grab irons
- B. Sit down in operator's seat and secure seat belt
- C. Raise blade to clear ground
- D. Release parking brake and transmission lock
- E. Select travel speed, and proceed to area where fire break is to be made
- F. Downshift to working speed and position the circle to sidecast material (toe of blade behind front tire)
- G. Lower blade to ground and begin stripping material from center to outside
- H. Continue cutting firebreak, making any adjustments necessary to keep the machine moving and sidecasting material

  (NOTE: Speed is of great importance.)
- I. When end of lane is reached, turn grader around and line up to sidecast from center to opposite side
- J. Continue return cut, making any adjustments; lean wheels in opposite direction of blade toe to counteract sidedraft

GRADERS
UNIT V

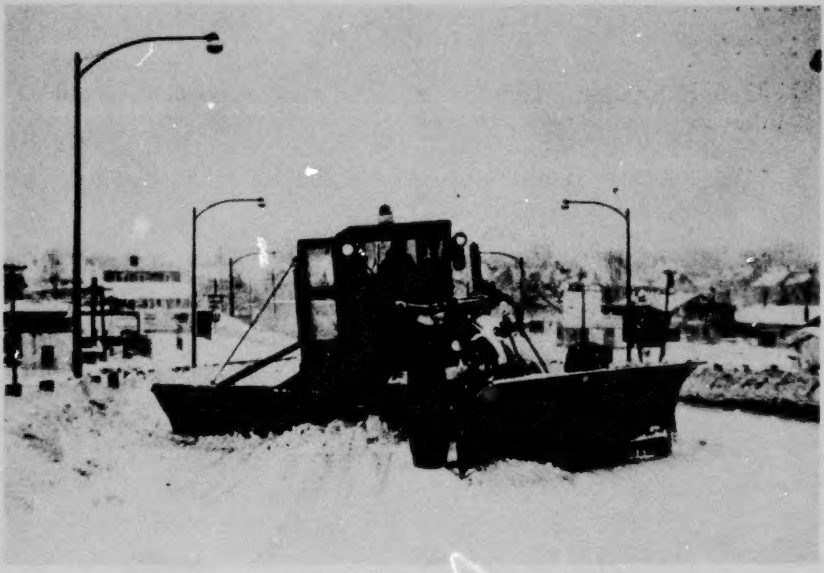
JOB SHEET #4--REMOVE SNOW

I. Equipment and material (Figure 6)

   A. Grader

   B. Snow on road

FIGURE 6



Courtesy of Clark Equipment Company, Construction Machinery Division.

II. Procedure

   A. Mount grader using steps and grab irons

   (CAUTION: Steps and irons could have ice on them.)

   B. Sit down in operator's seat and secure safety belt

   C. Raise blade off ground

   D. Release parking brake and transmission lock

   E. Select travel speed, and move to area of road to be cleared

   F. Downshift to working speed

   G. Rotate circle to sidecast material

JOB SHEET #4

H. Line up left front wheel of grader on center line of road

I. Lower blade to just touch pavement

J. Lean wheels in direction of sidecast snow

K. Continue removing snow until destination is reached

L. Raise blade, and turn machine around

M. Reposition grader on opposite side of road for return pass

N. Line up left side, placing wheel on grade area

O. Lower blade to pavement and continue snow removal while making any adjustments necessary to avoid scarring the road

P. When area is cleared of snow, raise blade and move to another area to be cleared

GRADERS
UNIT V

JOB SHEET #5--BLEND AND SPREAD MATERIAL ON A ROADBED

I. Equipment and materials

A. Grader (Figure 7)

B. Tool kit

FIGURE 7

Courtesy of Deere & Company.

II. Procedure

A. Loosen bolts through blade beams and tilting links

B. Adjust blade to forward position

(NOTE: This will create a rolling and mixing action.)

C. Retighten adjusting bolts on blade beams and tilting links

D. Proceed to work area

E. Start first pass, windrowing material

F. Continue windrowing and blading material back and forth until mix is uniform

G. After obtaining designated mix, angle blade 20°-30° and spread material on road by windrowing back and forth across road

GRADERS
UNIT V

JOB SHEET #6--PERFORM V-TYPE DITCH CONSTRUCTION

I. Equipment--Grader

II. Procedure

A. Interpret data on ditch stake

B. Operate sideshift to extreme left

C. Rotate circle until point of blade is directly behind right front wheel (Figure 8)

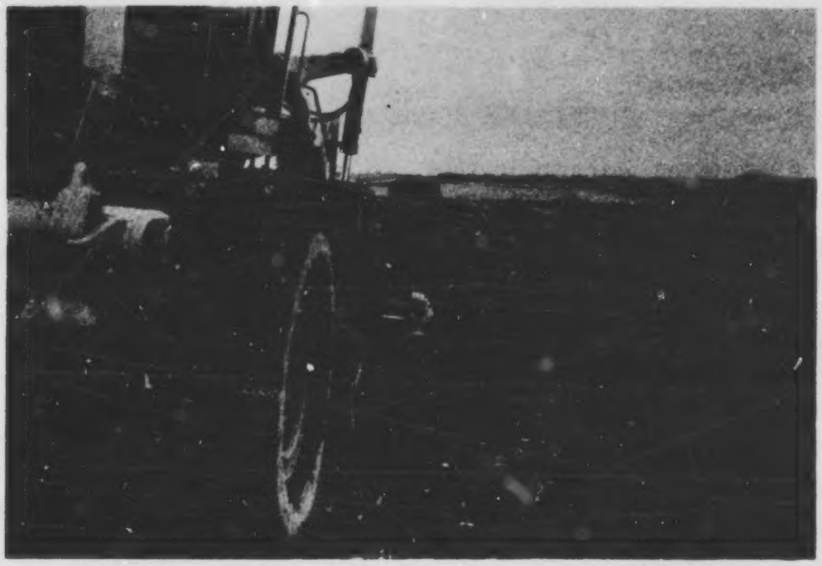
FIGURE 8

Courtesy of Caterpillar Tractor Company.

JOB SHEET #6

D. Raise the left lift cylinder to full "up" position (Figure 9)

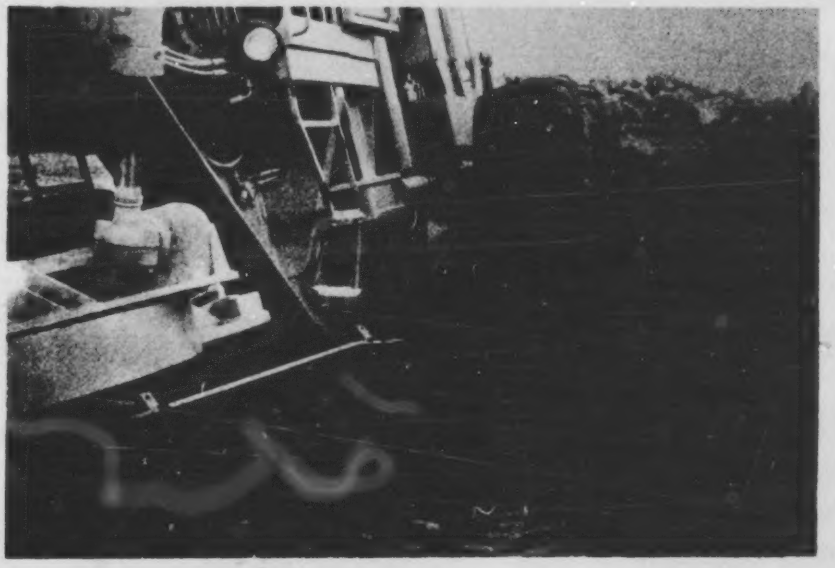
FIGURE 9



Courtesy of Caterpillar Tractor Company.

E. Lower right blade lift cylinder to set blade tip for desired depth of cut (Figure 10)

FIGURE 10



Courtesy of Caterpillar Tractor Company.

JOB SHEET #6

F. Lean front wheels to left and make 4" to 5" marking cut

(NOTE: Leaning will counteract sidedraft of blade. Keep blade toe in line with outside edge of lead tire while maintaining a straight line.)

G. Continue cutting to desired depth, keeping front tire in bottom of ditch (Figure 11)

(NOTE: Each ditch cut should be made as deep as possible with blade toe in line with center of lead tire, and without stalling grader.)

FIGURE 11

Courtesy of Caterpillar Tractor Company.

H. Continue ditching and bringing successive cuts in from edge of bank slope; blade toe will be in line with bottom of ditch on the final cut

GRADERS
UNIT V

TEST

NAME ______________________________ SCORE ______________

1. List uses of graders.

    a. ____
    b. ____
    c. ____
    d. ____

2. Match terms associated with grader to their correct definitions. Write the correct numbers in the blanks.

_____a. Jointed

_____b. Attachments used to increase the effectiveness of a machine's use

_____c. Fill

_____d. Shallow loosening of road surface

_____e. Ridge of loose dirt

_____f. Hub stakes used during final grading process when existing grade is within 0.2' of desired grade (marked with blue keel)

_____g. To mix materials until they are uniform

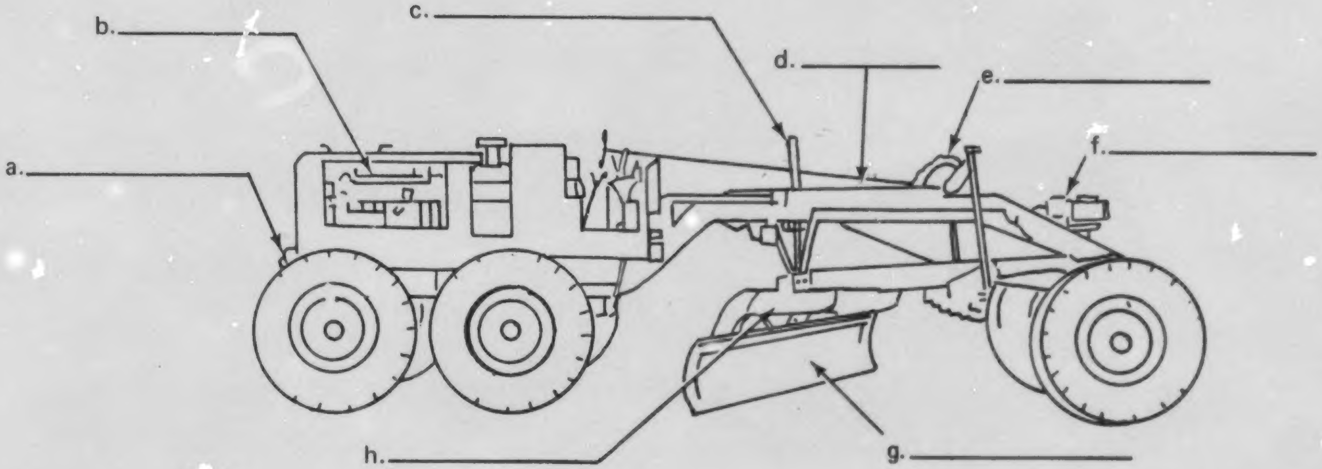
_____h. Area cleared of combustible materials

_____i. Colored marking crayon used to mark tops of blue-top stakes

1. Blue tops
2. Windrow
3. Scarify
4. Articulated
5. Top off
6. Accessories
7. Fire break
8. Blend
9. Keel

TEST

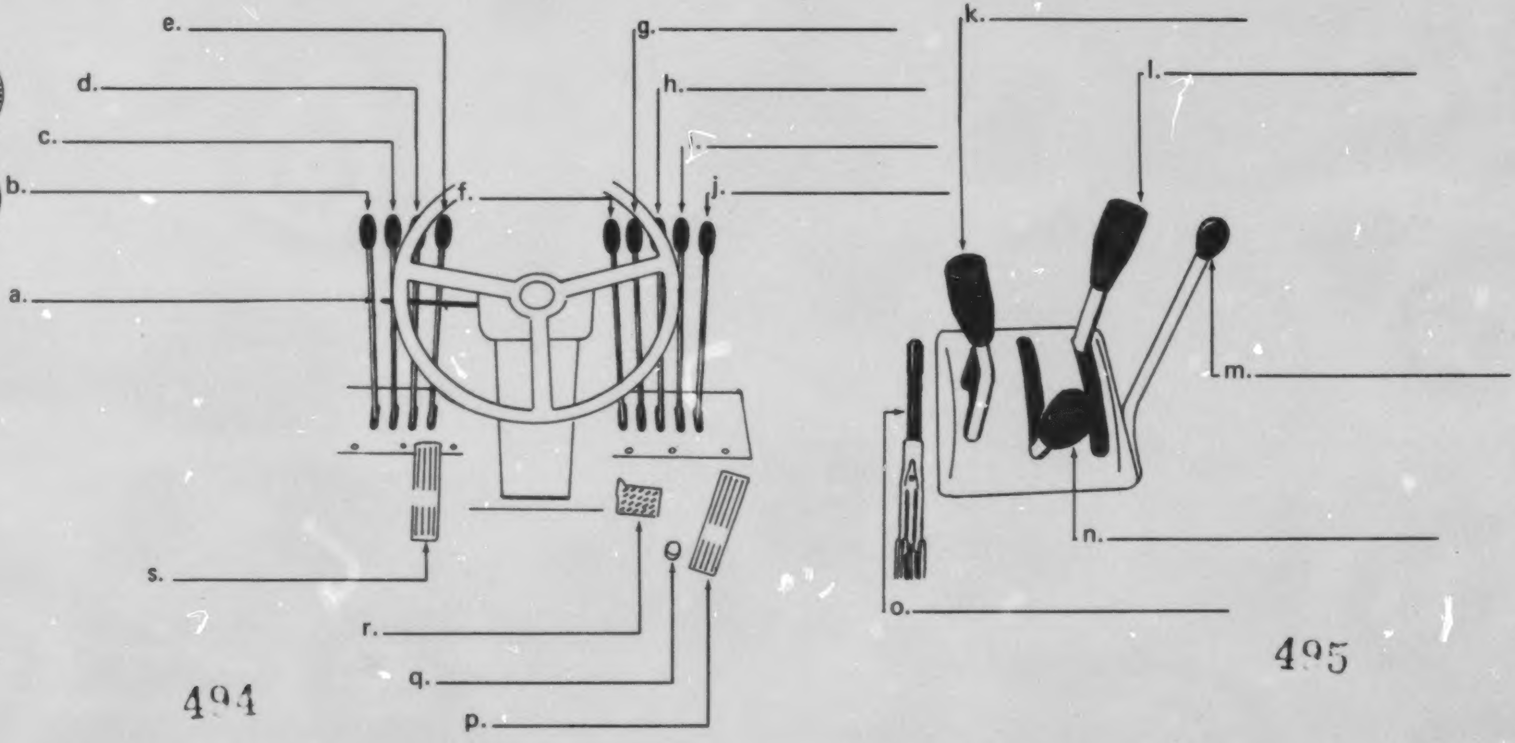
3. Label basic parts of the grader illustrated below. Write the correct names in the blanks.



TEST

4. Identify controls on a typical grader. Write the correct names in the blanks.

Turn signals and emergency flasher
Decelerator pedal
Accelerator pedal
Parking brake lever
Saddle pin release button
Foot brake
Gear range lever
Output shaft governor
Engine speed control
Forward/reverse control
Left-hand blade lift
Circle rotation
Scarifier
Blade tilt
Blade shift
Wheel lean
Circle shift
Articulation control
Right-hand blade lift



TEST

5. List ten accessories used on graders.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

i. ____________________

j. ____________________

6. Select from the following list types of jobs done with graders. Write an "X" in the blank before each correct answer.

_____a. Scarifying

_____b. Mixing and spreading materials

_____c. Compacting

_____d. Leveling

_____e. Crawler towing

_____f. V-type ditch construction

_____g. Plowing

_____h. Land clearing

_____i. Snow removal

_____j. Finish grading

_____k. Road maintenance

_____l. Ditch dredging

TEST

7. State six suggestions for effective grader operations.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

8. List eight safety precautions to observe while operating a grader.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

9. List ten items to check on a daily inspection.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

h. ____

i. ____

j. ____

TEST

10. Select from the following list items to check after warm-up. Write an "X" in the blank before each correct answer.

_____a. Fuel tank

_____b. Operator's manual

_____c. Operator's cab

_____d. Performance of components, by operating controls

_____e. All gauges, for proper pressures and temperatures

_____f. Pressures and temperatures of controls

_____g. Equipment, for unusual noise or vibration

(NOTE: Test question 11 lists the job sheets. These are an important part of this unit. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

a. Service a grader.

b. Make a windrow.

c. Cut a firebreak.

d. Remove snow.

e. Blend and spread material on a roadbed.

f. Perform V-type ditch construction.

GRADERS
UNIT V

ANSWERS TO TEST

1. a. Cutting
   b. Shaping
   c. Earth moving
   d. Fine grading

2. a. 4
   b. 6
   c. 5
   d. 3
   e. 2
   f. 1
   g. 8
   h. 7
   i. 9

3. a. Rear drawbar hitch
   b. Engine
   c. Moldboard lift cylinder
   d. Frame
   e. Saddle
   f. Steering gear
   g. Moldboard
   h. Drawbar and circle

4. a. Turn signals and emergency flasher
   b. Left-hand blade lift
   c. Scarifier
   d. Circle rotation
   e. Blade tilt
   f. Blade shift
   g. Wheel lean
   h. Circle shift
   i. Articulation control
   j. Right-hand blade lift
   k. Forward/reverse control
   l. Engine speed control
   m. Output shaft governor
   n. Gear range lever
   o. Parking brake lever
   p. Accelerator pedal
   q. Saddle pin release button
   r. Foot brake
   s. Decelerator pedal

ANSWERS TO TEST

5. Answer should include any ten of the following
   a. Snowplow
   b. Side wing
   c. Bank sloper
   d. Scarifier
   e. Ripper
   f. Rake blade
   g. Belt loader
   h. Arm-mounted clearing tool
   i. Dozer blade
   j. Trailer drag
   k. Disc harrow
   l. Laser power and/or sensor

6. a, b, d, f, i, j, k

7. Answer should include any six of the following
   a. Do not work machine over capacity
   b. Travel at highest practical travel speed
   c. Use extreme care when turning on a downgrade
   d. Service equipment regularly to ensure efficient operation
   e. Keep equipment clean
   f. Set up work cycle so it will be as short as possible
   g. Calculate and plan operations before starting
   h. Protect grader from dust and sand as much as possible
   i. When front end tends to veer out of line, lean wheels in opposite direction enough to correct and hold machine in line; when rear module veers, move it in opposite direction enough to correct and hold machine in line
   j. Always use decelerator or throttle to slow engine speed when shifting
   k. Avoid excessive speed, particularly on rough ground

8. Answer should include any eight of the following
   a. Wear safety items required by job conditions
   b. Know and observe hand signals
   c. Be sure all safety guards and covers are secured and in place

ANSWERS TO TEST

    d. Do not back machine until you are sure personnel and obstructions are clear
    e. Check all safety devices before moving machine
    f. Do not jump on or off machine
    g. Do not allow anyone to ride on machine
    h. Know traffic pattern of job and obey signal person
    i. Always park on level ground, if possible
    j. Apply down pressure on blade and block wheels, if necessary, to park on a grade
    k. Do not leave machine's engine running unattended
    l. Avoid operating too close to banks or overhangs

9. Answer should include any ten of the following
    a. Visual inspection for broken, worn, or missing parts and leaks
    b. Engine oil level
    c. Engine coolant level
    d. Fuel level
    e. Hydraulic reservoir level
    f. Battery electrolyte level, cables, and connectors
    g. Tire pressure and condition
    h. Air cleaner
    i. Drive belts
    j. Wire connections and insulation
    k. Moldboards, cutting edges, end boots, and scarifier
    l. Windshield and wipers (when applicable)
    m. Brakes and brake fluid
    n. Cleanliness of equipment
    o. Exhaust system

ANSWERS TO TEST

p. Safety devices

q. Gauges and controls for proper functioning

r. Major components

10. d, e, g

11. Performance skills evaluated to the satisfaction of the instructor

COMPACTING EQUIPMENT
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to perform compaction jobs in accordance with project specifications. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of compacting equipment.
2. Match terms associated with compacting equipment to their correct definitions.
3. List types of compacting equipment.
4. List types of rollers.
5. Identify types of tampers and vibrators.
6. Identify controls on a typical roller.
7. Identify controls on a typical wheel tractor.
8. Describe rollers, tampers, and vibrators.
9. State suggestions for effective roller operations.
10. List safety procedures to observe when operating rollers.
11. Select from a list items that should be checked on a daily inspection.
12. Select from a list procedures for servicing a roller.
13. List materials and equipment necessary to perform service on compacting equipment.
14. Demonstrate the ability to
    - a. Start, warm up, check gauges, and test controls for performance; make final visual check.
    - b. Compact a pad with roller pulled by dozer.
    - c. Compact earthfill to project specifications.
    - d. Compact roadbed materials to project specifications.

COMPACTING EQUIPMENT
UNIT VI

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Order films and other materials planned to supplement unit.

      Film--*Heavy Construction Techniques Series: Construction Equipment, Part 2*. Color, 15 min., Northeast Louisiana University, 1980. Available from Bobbs Merrill Educational Publishing, 4300 West 62nd St., P.O. Box 7080, Indianapolis, Indiana 46206.

   B. Provide students with objective sheet.

   C. Provide students with information, assignment, and job sheets.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Demonstrate and discuss procedures outlined in job sheets.

   G. Provide different jobs if job sheets are not practical.

   H. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment Sheet #1--List Materials and Equipment Necessary to Perform Service on Compacting Equipment

   E. Answers to assignment sheet

   F. Job sheets

      1. Job Sheet #1--Start, Warm Up, Check Gauges, and Test Controls for Performance; Make Final Visual Check

      2. Job Sheet #2--Compact a Pad with Roller Pulled by Dozer

      3. Job Sheet #3--Compact Earthfill to Project Specifications

      4. Job Sheet #4--Compact Roadbed Materials to Project Specifications

   G. Test

   H. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. Nichols, H. L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

B. *Galion Operators Manual No. 8200: Model V052-66A Vibratory Roller, Serial No. 47003 and Up.* Galion Manufacturing Division, Dresser Industries, Inc., Galion, Ohio.

C. Hyster Company, Construction Equipment Division, Kewanee, Illinois.

COMPACTING EQUIPMENT
UNIT VI

INFORMATION SHEET

I. Uses of compacting equipment (Figure 1)

   A. Obtain densities to provide desired strengths and carry specified loads without excess settlement

   B. Achieve compaction of earth, gravel, and asphalt

   C. Form a barrier that does not allow water to pass through

FIGURE 1

Courtesy of Galion Manufacturing Division, Dresser Industries, Inc.

II. Terms and definitions

   A. Compaction--Reduction in bulk of fill

   B. Fill--Soil or loose rock used to raise a grade

   C. Segmented--Divided into or composed of sections

   D. Articulated--Jointed

   E. Bituminous--Mineral pitch; asphalt-type paving material

III. Types of compacting equipment

   A. Rollers

   B. Tampers

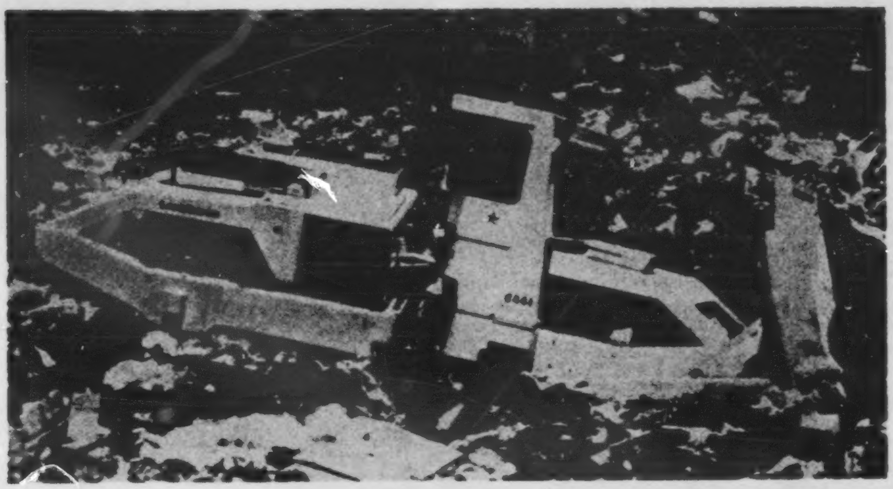
   C. Vibrators

INFORMATION SHEET

IV. Types of rollers (Figures 2-18)

A. Articulating-frame, double-drum compactor with tamping feet

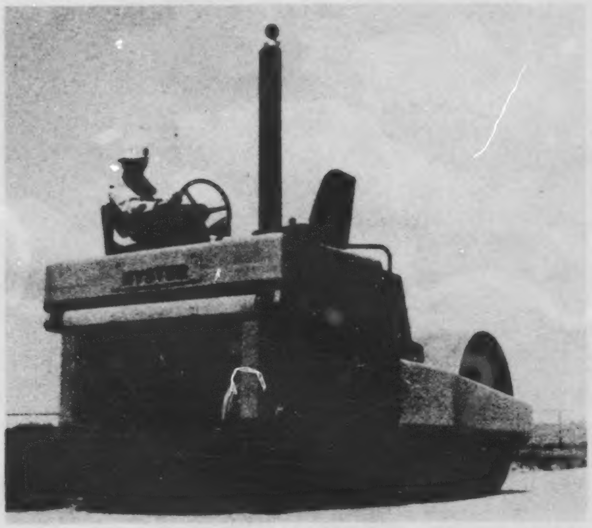
FIGURE 2



Courtesy of the Hyster Company, Construction Equipment Division.

B. Self-propelled vibratory roller (single-drum)

FIGURE 3

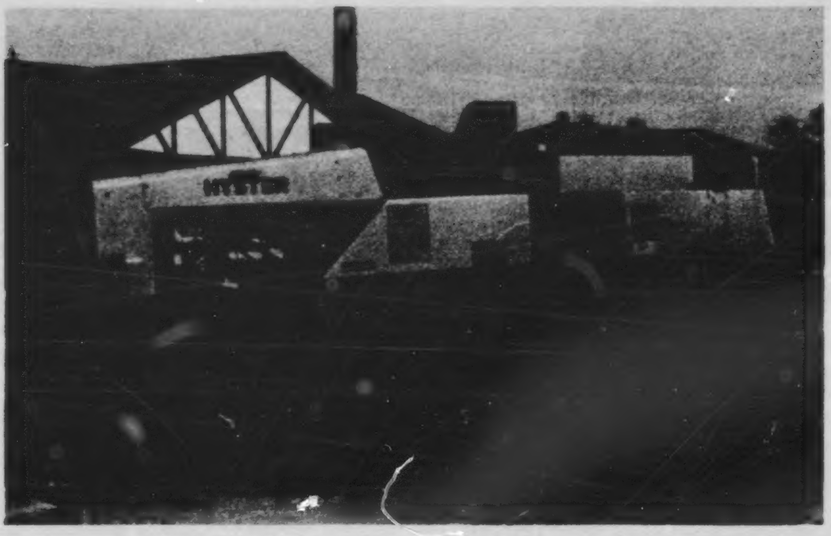


Courtesy of the Hyster Company, Construction Equipment Division.

INFORMATION SHEET

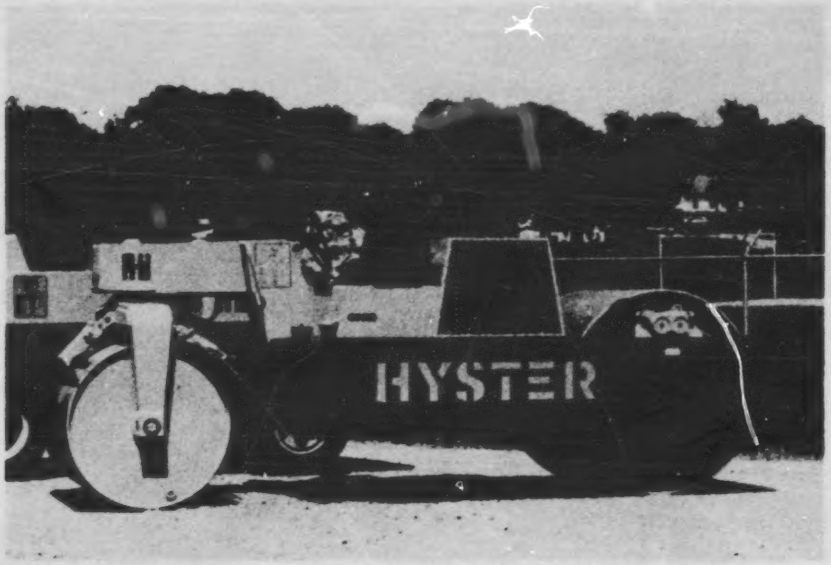
C. Articulated-steering, self-propelled pneumatic roller

FIGURE 4



D. Two-drum, steel-wheel roller with water spray system

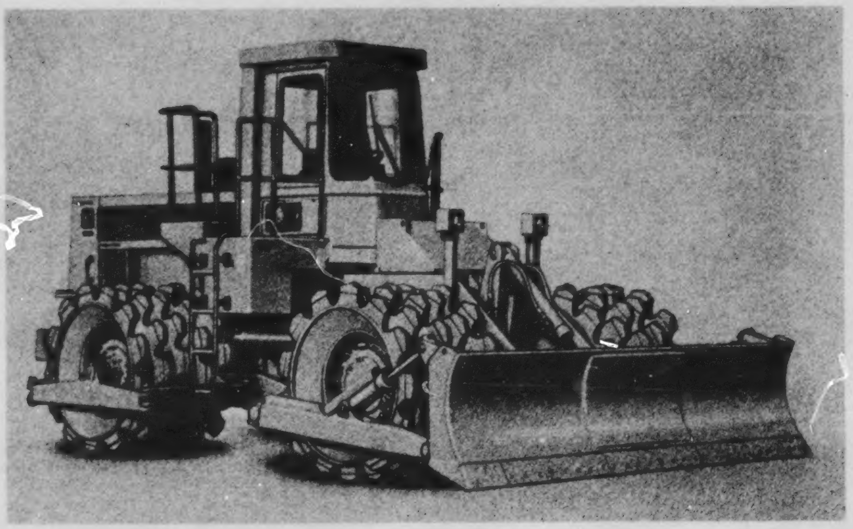
FIGURE 5



INFORMATION SHEET

E. Articulated-frame steering compactor with blade (tamping-foot design)

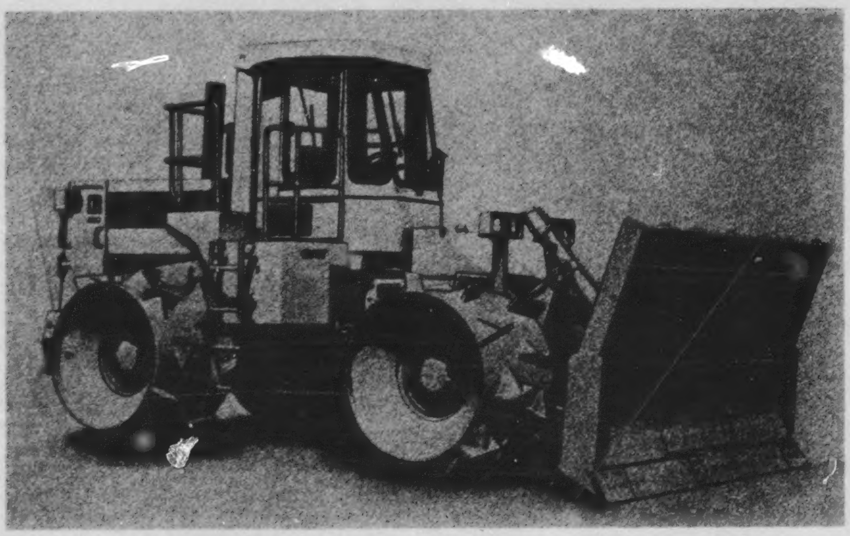
FIGURE 6



Courtesy of the Caterpillar Tractor Company.

F. Landfill compactor, center-point articulation

FIGURE 7



Courtesy of the Caterpillar Tractor Company.

INFORMATION SHEET

G. Self-propelled, pneumatic-tired roller

FIGURE 8

Courtesy of Galion Manufacturing Division, Dresser Industries, Inc.

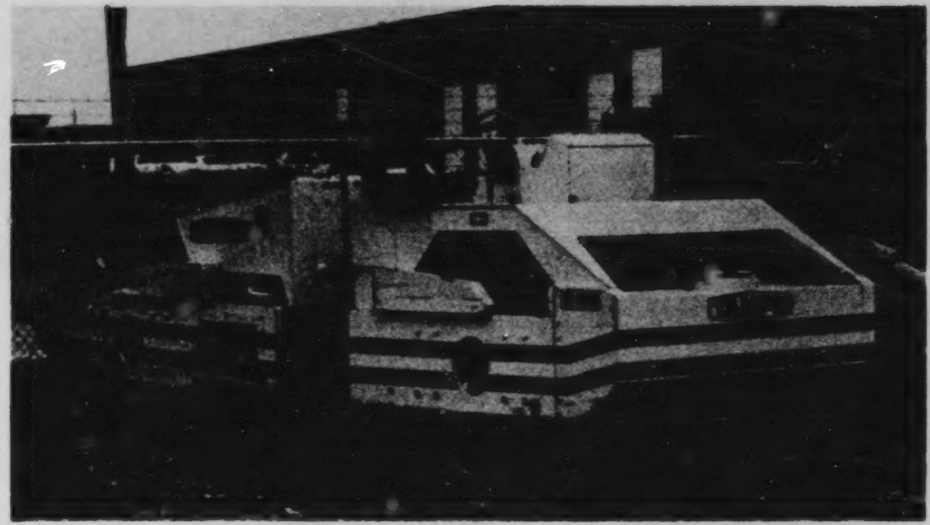
H. Pull-type, pneumatic-tired roller

FIGURE 9

INFORMATION SHEET

I. Two-axle tandem roller

FIGURE 10



Courtesy of Tampo Manufacturing Company.

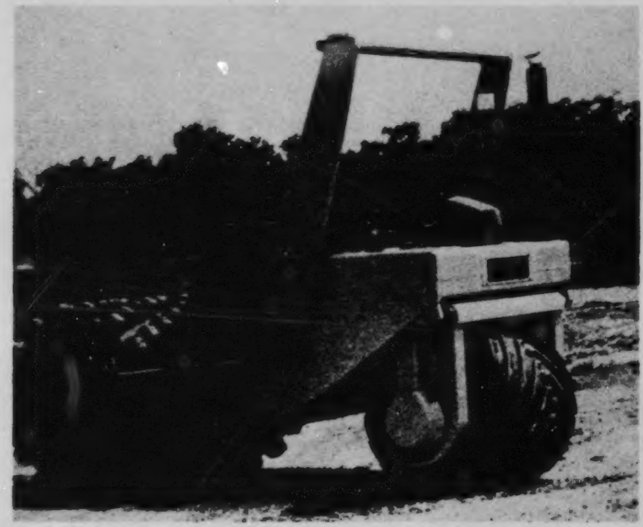
J. Vibrating, articulating, self-propelled roller

FIGURE 11

INFORMATION SHEET

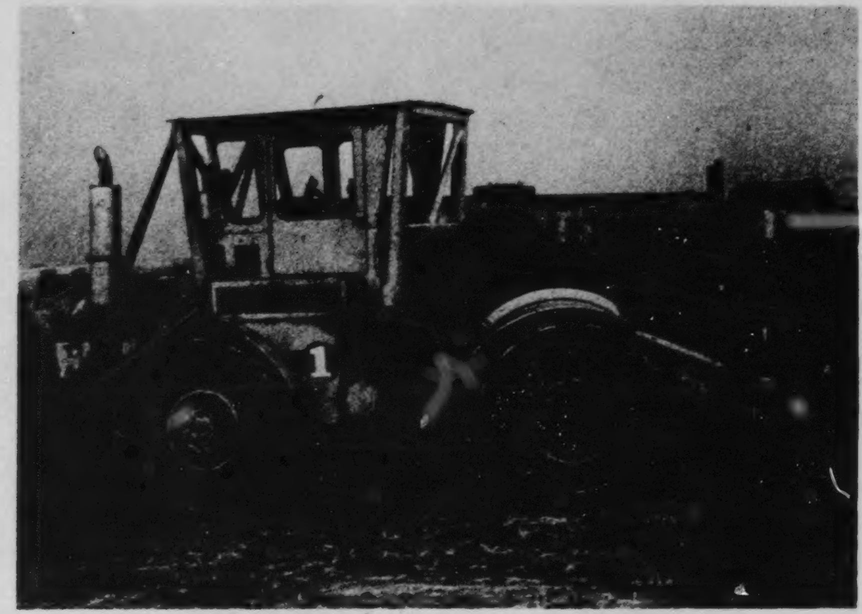
K. Single-drum, tamping-feet, vibratory compactor

FIGURE 12



L. Steel-wheeled, articulated compactor with dozer blade

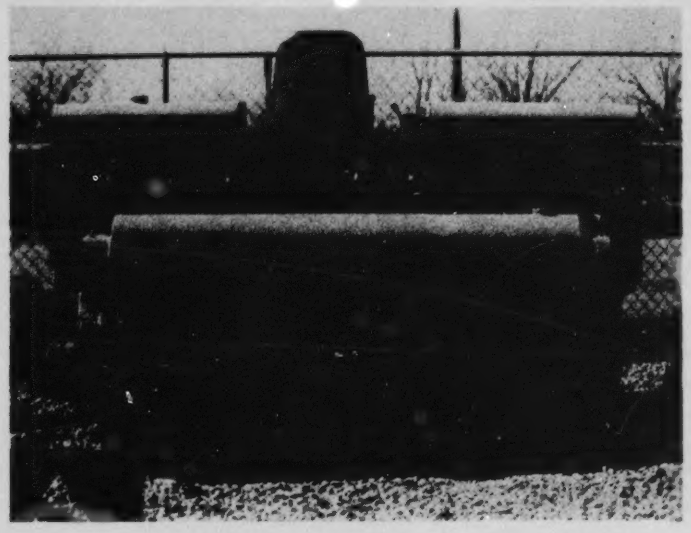
FIGURE 13



INFORMATION SHEET

M. Self-propelled vibrator compactor

FIGURE 14



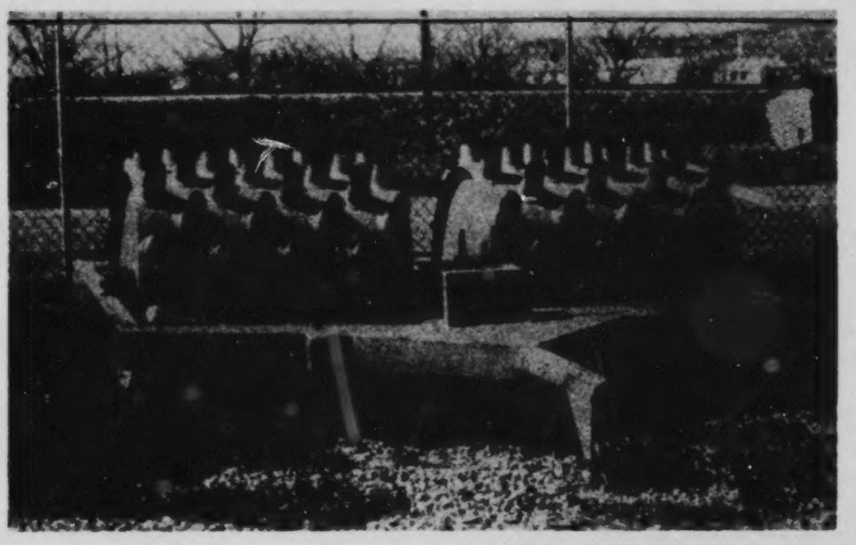
N. Self-propelled, articulating sheepsfoot roller

FIGURE 15

INFORMATION SHEET

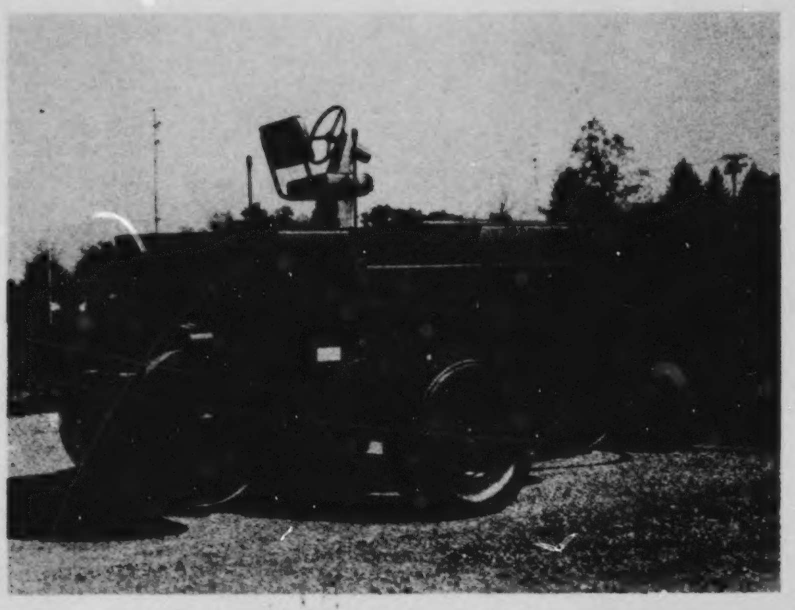
O. Pull-type sheepsfoot roller

FIGURE 16



P. Portable tandem roller

FIGURE 17



Courtesy of Galion Manufacturing Division, Dresser Industries, Inc.

INFORMATION SHEET

Q. Articulating-frame, two-drum embankment compactor

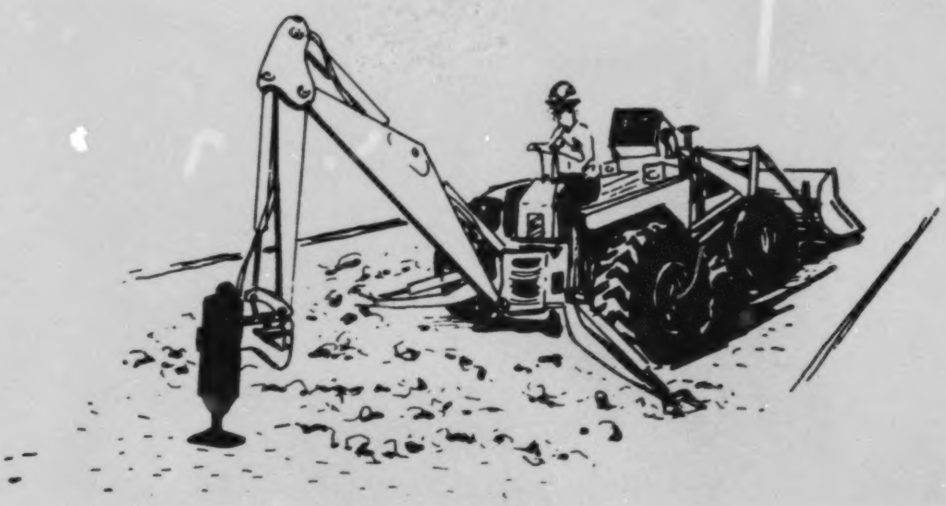
FIGURE 18

Courtesy of the Hyster Company, Construction Equipment Division.

V. Types of tampers and vibrators (Figures 19-22)

A. Backhoe with tamper attachment

FIGURE 19

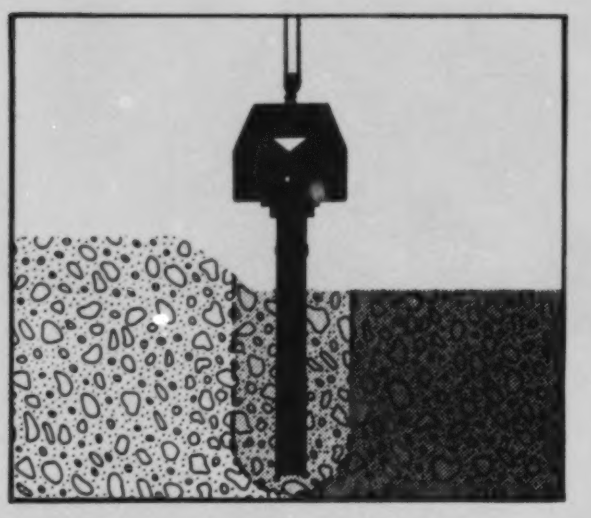


Courtesy of Vulcan Iron Works, Inc.

INFORMATION SHEET

B. Vibratory probe

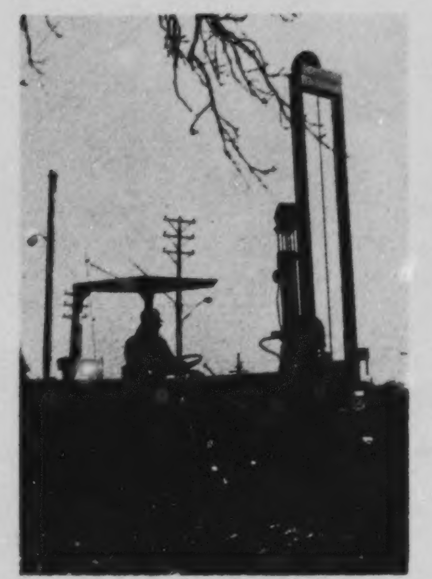
FIGURE 20



Courtesy of L. B. Foster Company.

C. Weight-dropping tamper

FIGURE 21

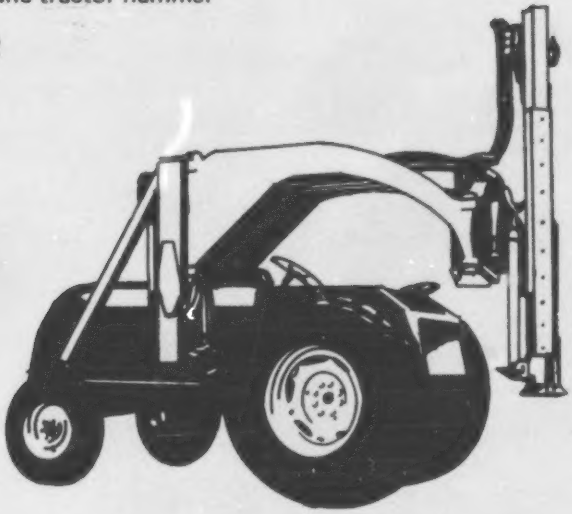


Courtesy of Arrow Manufacturing Company, Division of E.M.M.P. Company.

INFORMATION SHEET

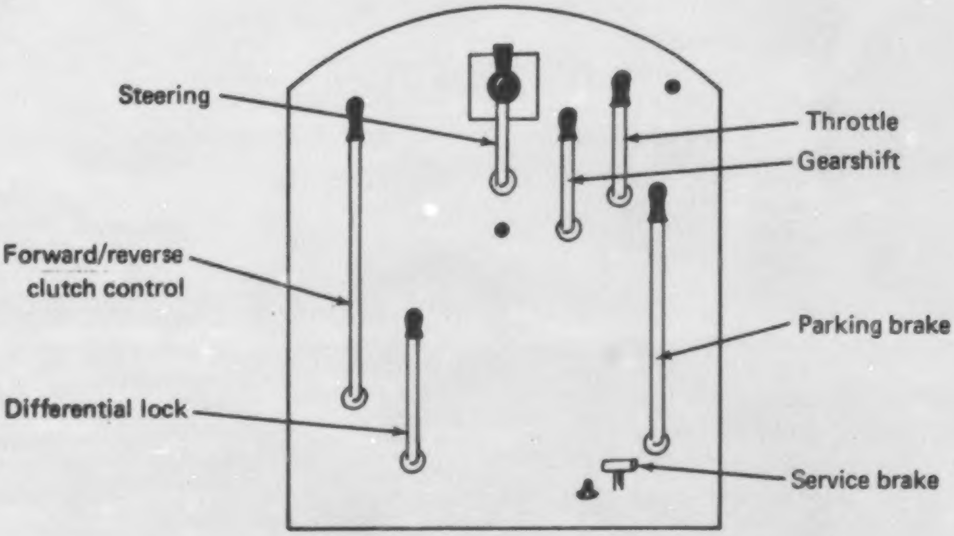
D. Hydraulic tractor hammer

FIGURE 22



VI. Controls on a typical roller (Figure 23)

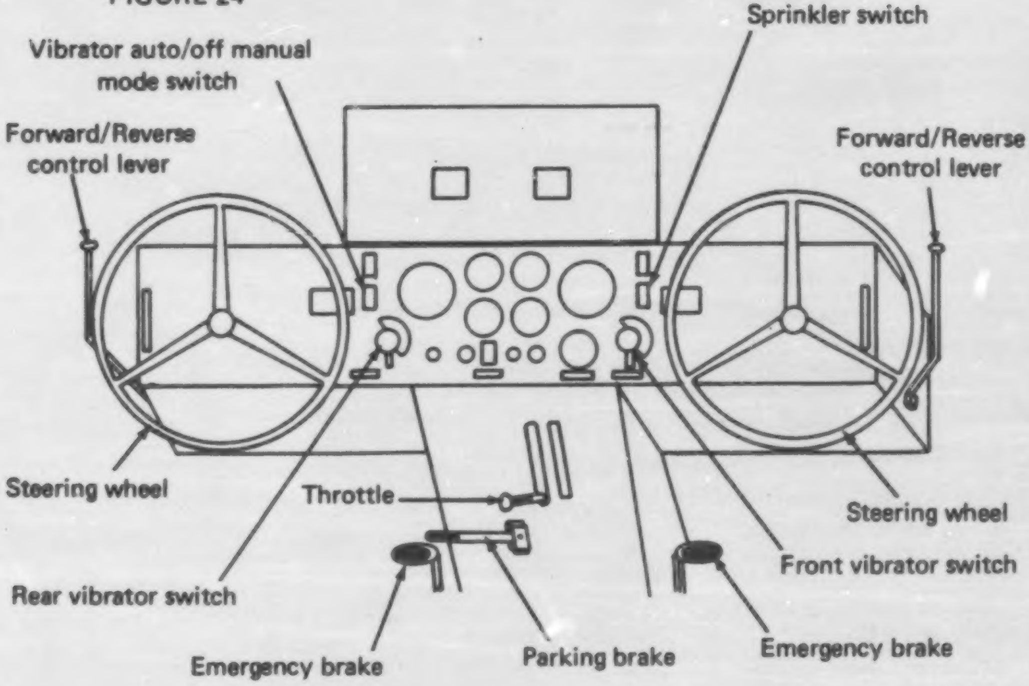
FIGURE 23


Steering
Throttle
Gearshift
Forward/reverse clutch control
Parking brake
Differential lock
Service brake

INFORMATION SHEET

VII. Controls on a typical wheel tractor (Figure 24)

FIGURE 24


Vibrator auto/off manual mode switch
Sprinkler switch
Forward/Reverse control lever
Forward/Reverse control lever
Steering wheel
Throttle
Steering wheel
Front vibrator switch
Rear vibrator switch
Emergency brake
Parking brake
Emergency brake

Used with permission of Galion Manufacturing, Division of Dresser Industries, Inc.

VIII. Descriptions of rollers, tampers, and vibrators

A. Rollers--Compress material by dead or static weight

B. Tampers--Compact soil in areas not accessible to rollers

C. Vibrators--Develop pressure waves which penetrate soil, setting its particles in motion; if static pressure is exerted, the combined effect rearranges particles and forces them into a compact structure

IX. Suggestions for effective roller operations

A. Keep grid and sheepsfoot-type rollers clean

B. Arrange work sequences so that turns are made while moving forward

C. Never turn too sharply

D. Always work from bottom to top on side slopes

INFORMATION SHEET

- E. Roll as many sections as are ready for work at one time
- F. Maintain equipment regularly

X. Safety procedures to observe when operating rollers

- A. Wear protective clothing and safety devices required by job conditions
- B. Never leave machine running unattended
- C. Never mount or dismount while machine is moving
- D. Never disengage or remove safety devices
- E. Never permit riders on equipment
- F. Be sure all bystanders are clear before starting operations
- G. Know and respond to hand signals given by signal person
- H. Use extreme caution on slopes and grades
- I. Follow proper traffic patterns

XI. Items that should be checked on a daily inspection

(NOTE: Deficiencies should be noted on a pad.)

- A. Possible broken, worn, or missing parts, and leaks
- B. Engine oil level
- C. Engine coolant level

  (CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)
- D. Fuel level
- E. Hydraulic reservoir fluid level
- F. Battery electrolyte level, cables, and connections

  (NOTE: Keep sparks and fire away from battery.)
- G. Air cleaner
- H. Brakes and brake fluid level
- I. Tires, where applicable
- J. Transmission fluid level
- K. Exhaust system

INFORMATION SHEET

L. Wire connections and insulation

M. Drive belt adjustment

N. Safety devices

O. Grease fittings

P. Major components and/or accessories

Q. Cleanliness of equipment

R. Proper functioning of gauges and controls

XII. Procedures for servicing a roller (Assignment Sheet #1)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Report and repair damaged, worn, or missing parts

B. Change engine oil

C. Add engine coolant if necessary; check radiator cap, hose and radiator

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

D. Fill fuel tank

E. Add hydraulic fluid if required

F. Add water or electrolyte to battery if necessary

(NOTE: Keep sparks and fire away from battery.)

G. Clean and service air cleaner

H. Check drive belts for tension and wear

I. Check brakes and adjust if necessary

J. Check tire pressure and condition where applicable

K. Add transmission oil if necessary

L. Repair or replace wires and connections if necessary

M. Adjust or replace drive belts if necessary

INFORMATION SHEET

N. Clean grease fittings and lubricate

O. Add water to watering system tanks

P. Check cleanliness of equipment

Q. Check for proper functioning of gauges and controls

COMPACTING EQUIPMENT
UNIT VI

ASSIGNMENT SHEET #1–LIST MATERIALS AND EQUIPMENT NECESSARY TO PERFORM SERVICE ON COMPACTING EQUIPMENT

NAME ______________________________ SCORE ______________

List materials and equipment necessary to perform service on compacting equipment. Use the Information Sheet in this unit for reference.

A. ____

B. ____

C. ____

D. ____

E. ____

F. ____

G. ____

H. ____

I. ____

J. ____

K. ____

L. ____

M. ____

N. ____

COMPACTING EQUIPMENT
UNIT VI

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

(NOTE: Because of the different manufacturers and types of equipment, all answers should be evaluated to the satisfaction of the instructor.)

A. Tool kit and new parts if necessary

B. Engine oil

C. Engine coolant and hydrometer

D. Gasoline or diesel fuel

E. Hydraulic fluid

F. Water, hydrometer, capacity tester, post and connector brush, clamp puller, fibre brush, baking soda, anti-corrosion paste, rags

G. Cleaning solvent, brush, rags, air supply, and new filter if necessary

H. Brake fluid and adjusting tools

I. Tire pressure gauge and air supply

J. Transmission fluid

K. New wires and/or connections and insulation if necessary

L. Rule or tension gauge

M. Rags, lubricating grease recommended by manufacturer, and grease gun

N. Water supply

COMPACTING EQUIPMENT
UNIT VI

JOB SHEET #1--START, WARM UP, CHECK GAUGES, AND TEST CONTROLS FOR PERFORMANCE; MAKE FINAL VISUAL CHECK

I. Equipment and materials

  A. Self-propelled compactor

  B. Operator's manual

  (NOTE: Refer to operator's manual for proper operating temperatures and pressures.)

II. Procedure

  A. Mount machine using steps and grab irons

  B. Insert key in disconnect switch

  C. Place all controls in neutral

  D. Start unit and allow oil pressure to come up to operating range at low rpm

  E. Check gauges to be sure all systems are functioning properly

  F. Check steering, brakes, and vibrator (if equipped)

  G. Dismount machine using steps and grab irons

  H. Make final inspection, checking for leaks and listening for any unusual noises or vibrations

  I. Remount machine

  J. Fasten seat belt

  K. Select proper gear and move to work area

COMPACTING EQUIPMENT
UNIT VI

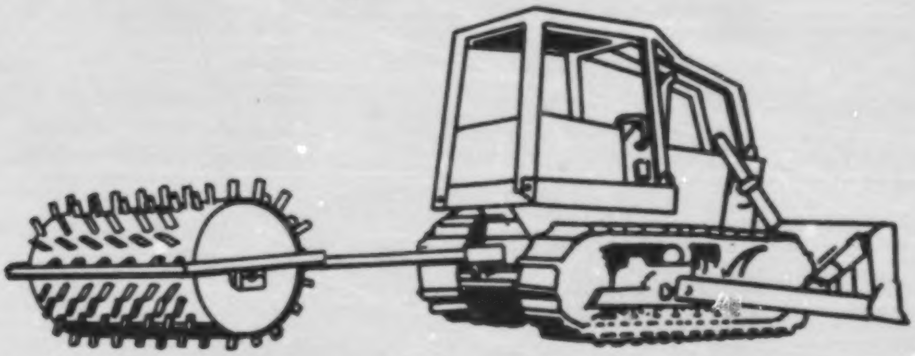
JOB SHEET #2–COMPACT A PAD WITH ROLLER PULLED BY DOZER

(NOTE: Compact material until the roller feet penetrate only about 1 inch into the material. The pad to be compacted is an area 50 feet wide by 100 feet long.)

I. Equipment and materials (Figure 25)

- A. Roller
- B. Bulldozer
- C. Lift of moist clay 1 foot deep spread over entire area

FIGURE 25



II. Procedure

- A. Mount dozer using steps and grab irons
- B. Sit in seat and secure seat belt
- C. Raise blade off ground to clear obstacles
- D. Release brake and transmission lock
- E. Select first forward gear and travel to location of roller
- F. Line up dozer in front of roller

JOB SHEET #2

G. Select first reverse gear and slowly move backward

(NOTE: Observe backward movement and alignment of roller tongue.)

H. Stop dozer immediately when signal person gives signal

I. Depress decelerator and brake

J. Place transmission in neutral position

K. Complete connections and move out when signal is given

L. Select first forward gear and travel to work area

M. Observe forward speed, and align right side of roller with right side of pad

N. Travel straight along the length of pad

O. Maintain low engine speed to provide proper speed and to avoid engine lugging

P. Turn left gradually when approaching end of pad

Q. Align roller with right edge of end of pad

(NOTE: Care must be taken during turn to avoid kicking out material on right side of tracks and causing irregularities on pad.)

R. Select first reverse gear and slowly move backward over area that was missed when turn was made

(NOTE: When backing, turn in seat and observe movement; observe when bottom of roller drum reaches the edge of pad.)

S. Select first forward gear and slowly move forward

T. Continue this procedure completely around the pad; then proceed to next pass, overlapping one-half of first pass

COMPACTING EQUIPMENT
UNIT VI

JOB SHEET #3--COMPACT EARTHFILL TO PROJECT SPECIFICATIONS

I. Materials and equipment

A. Compactor or self-propelled roller (Figure 26)

B. Lift of moist clay approximately 0.8' thick

FIGURE 26

Courtesy of Caterpillar Tractor Company.

II. Procedure

A. Mount machine using steps and grab irons

B. Sit in operator's seat and buckle seat belt

C. Release parking brake and transmission lock

D. Pull throttle to full rpm and select safe travel speed

E. Travel to lift area

F. Begin compacting material, observing the sheepsfoot pad penetration

(NOTE: Operator may have to slow machine.)

JOB SHEET #3

G. Continue compacting; sheepsfoot will begin to walk out of the material because of less penetration

H. Continue compacting until the sheepsfoot penetrates only 0.05' to 0.10'; at this point compaction should be optimum for the next lift

I. Continue compacting until desired elevation is reached

COMPACTING EQUIPMENT
UNIT VI

JOB SHEET #4--COMPACT ROADBED MATERIALS TO PROJECT SPECIFICATIONS

I. Equipment--Self-propelled roller (smooth-drum) (Figure 27)

FIGURE 27

II. Procedure

A. Mount machine using steps and grab irons

B. Sit in operator's seat and buckle seat belt

C. Release parking brake and transmission lock

D. Pull throttle to full rpm and select safe travel speed

E. Travel to roadbed

F. Select working speed and begin compacting gravel

G. Turn vibrator to "on" position if machine is so equipped

H. Continue compacting, observing the gravel to be sure that it does not move away from the machine; if gravel does move away, either speed machine up or slow the vibration

I. Move off pad and allow water wagon to wet the lift of gravel

J. Resume compacting until the gravel is sealed smoothly

COMPACTING EQUIPMENT
UNIT VI

TEST

NAME ______________________________ SCORE ______________

1. List uses of compacting equipment.

   a. ____

   ____

   b. ____

   c. ____

2. Match terms associated with compacting equipment to their correct definitions. Write the correct numbers in the blanks.

_____a.	Reduction in bulk of fill	1. Fill
_____b.	Soil or loose rock used to raise a grade	2. Articulated
_____c.	Divided into or composed of sections	3. Compaction
_____d.	Jointed	4. Segmented
_____e.	Mineral pitch; asphalt-type paving material	5. Bituminous

3. List types of compacting equipment.

   a. ____

   b. ____

   c. ____

4. List ten types of rollers.

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

TEST

f. ______________________________

g. ______________________________

h. ______________________________

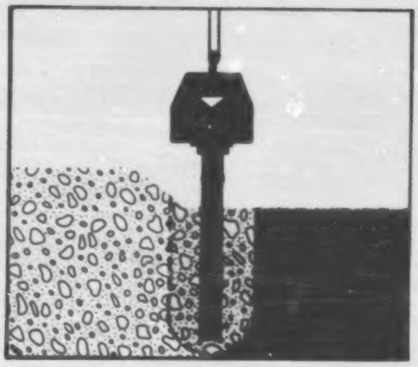
i. ______________________________

j. ______________________________

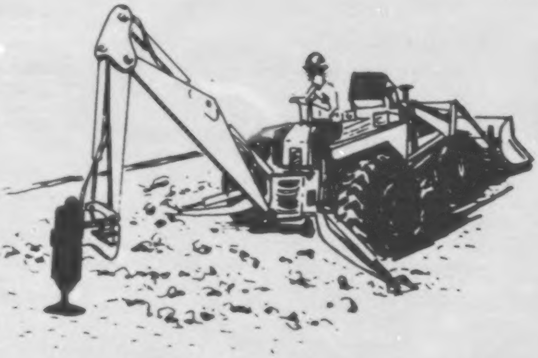
5. Identify types of tampers and vibrators. Write the correct names in the blanks.

Backhoe with tamper attachment | **Vibratory probe**

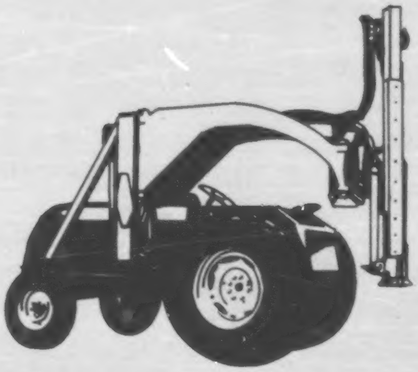
Hydraulic tractor hammer | **Weight-dropping tamper**



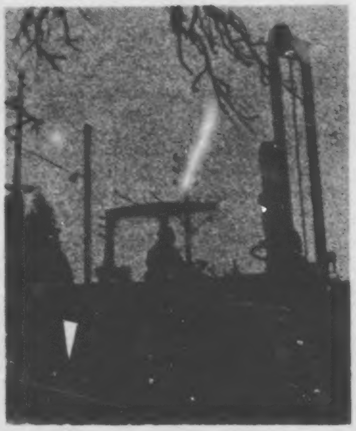
a. ______________________



b. ______________________



c. ______________________



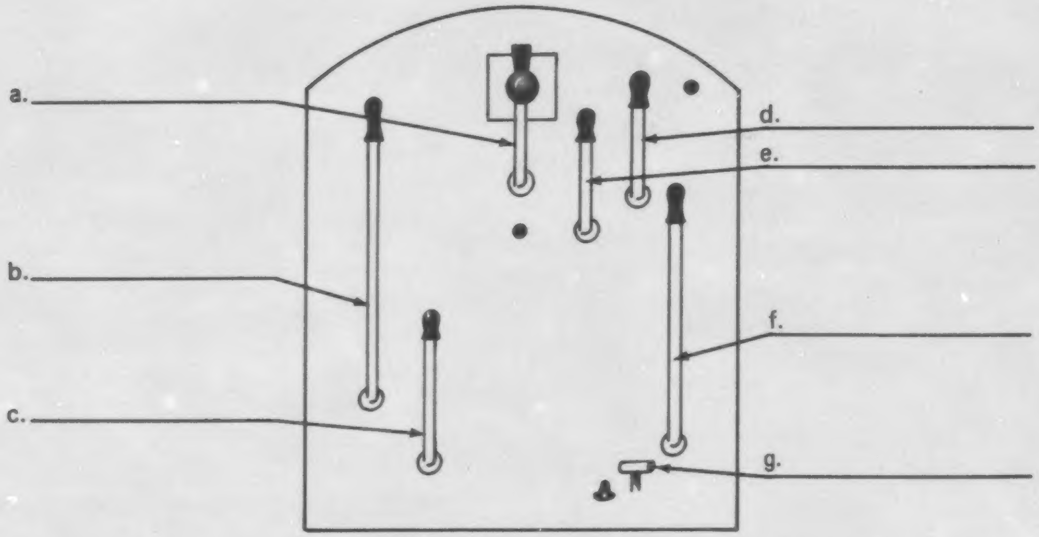
d. ______________________

531

TEST

6. Identify controls on a typical roller. Write the correct names in the blanks.

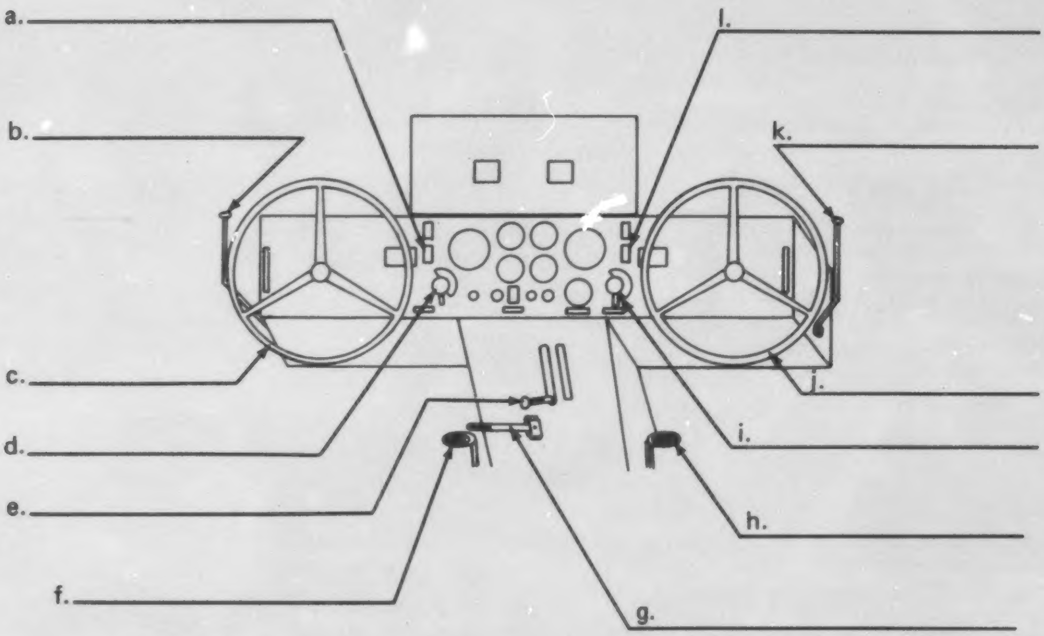
Steering	Parking brake
Forward/reverse clutch control	Throttle
Differential lock	Gearshift
Service brake	



TEST

7. Identify controls on a typical wheel tractor. Write the correct names in the blanks.

Vibrator auto/off/manual mode switch
Parking brake
Forward/reverse control lever
Emergency brake
Steering wheel
Sprinkler switch
Front vibrator switch
Rear vibrator switch
Throttle



8. Describe rollers, tampers, and vibrators.

a. Rollers-- ______________________________

____

b. Tampers-- ______________________________

____

c. Vibrators-- ______________________________

____

____

____

TEST

9. State five suggestions for effective roller operations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

10. List six safety procedures to observe when operating rollers.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

11. Select from the following list items that should be checked on a daily inspection. Write an "X" in the blank before each correct answer.

______a. Major components and/or accessories

______b. Steering pump pulley

______c. Drive belt adjustment

______d. Brakes and brake fluid level

______e. Water reservoir

______f. Possible broken, worn, or missing parts, and leaks

______g. Hydraulic reservoir fluid level

______h. Transmission belts

______i. Engine coolant level

______j. Engine compression

12. Select from the following list procedures for servicing a roller. Write an "X" in the blank before each correct answer.

______a. Add water to fire extinguisher

______b. Repair or replace wires and connections if necessary

TEST

______c. Check tire pressure and condition where applicable

______d. Report and repair all wire connections

______e. Check battery vent caps

______f. Check brakes and adjust if necessary

______g. Replace all drive belts

______h. Clean and service air cleaner

______i. Fill fuel tank

______j. Clean grease fittings and lubricate

______k. Check vibration rate of vibrating roller

______l. Add transmission oil if necessary

(NOTE: Test questions 13 and 14 list assignment and job sheets. These are an important part of this test. If they have not been completed, check with your instructor.)

13. List materials and equipment necessary to perform service on compacting equipment.

14. Demonstrate the ability to

    a. Start, warm up, check gauges, and test controls for performance; make final visual check.

    b. Compact a pad with roller pulled by dozer.

    c. Compact earthfill to project specifications.

    d. Compact roadbed materials to project specifications.

COMPACTING EQUIPMENT
UNIT VI

ANSWERS TO TEST

1. a. Obtain densities to provide desired strengths and carry specified loads without excess settlement

   b. Achieve compaction of earth, gravel, and asphalt

   c. Form a barrier that does not allow water to pass through

2. a. 3

   b. 1

   c. 4

   d. 2

   e. 5

3. a. Rollers

   b. Tampers

   c. Vibrators

4. Answer should include any ten of the following

   a. Articulating-frame, double-drum compactor with tamping feet

   b. Self-propelled vibratory roller (single-drum)

   c. Articulated-steering, self-propelled pneumatic roller

   d. Two-drum, steel-wheel roller with water spray system

   e. Articulated-frame steering compactor with blade (tamping-foot design)

   f. Landfill compactor, center-point articulation

   g. Self-propelled, pneumatic-tired roller

   h. Pull-type, pneumatic-tired roller

   i. Two-axle tandem roller

   j. Vibrating, articulating, self-propelled roller

   k. Single-drum, tamping-feet, vibratory compactor

   l. Steel-wheeled, articulated compactor with dozer blade

   m. Self-propelled vibrator compactor

   n. Self-propelled, articulating sheepsfoot roller

ANSWERS TO TEST

  o. Pull-type sheepsfoot roller

  p. Portable tandem roller

  q. Articulating-frame, two-drum embankment compactor

5. a. Vibratory probe

  b. Backhoe with tamper attachment

  c. Hydraulic tractor hammer

  d. Weight-dropping tamper

6. a. Steering

  b. Forward/reverse clutch control

  c. Differential lock

  d. Throttle

  e. Gearshift

  f. Parking brake

  g. Service brake

7. a. Vibrator auto/off/manual mode switch

  b. Forward/reverse control lever

  c. Steering wheel

  d. Rear vibrator switch

  e. Throttle

  f. Emergency brake

  g. Parking brake

  h. Emergency brake

  i. Front vibrator switch

  j. Steering wheel

  k. Forward/reverse control lever

  l. Sprinkler switch

ANSWERS TO TEST

8. Descriptions should include
   - a. Compress material by dead or static weight
   - b. Compact soil in areas not accessible to rollers
   - c. Develop pressure waves which penetrate soil, setting its particles in motion; if static pressure is exerted, the combined effect rearranges particles and forces them into a compact structure
9. Answer should include any five of the following
   - a. Keep grid and sheepsfoot-type rollers clean
   - b. Arrange work sequences so that turns are made while moving forward
   - c. Never turn too sharply
   - d. Always work from bottom to top on side slopes
   - e. Roll as many sections as are ready for work at one time
   - f. Maintain equipment regularly
10. Answer should include any six of the following
    - a. Wear protective clothing and safety devices required by job conditions
    - b. Never leave machine running unattended
    - c. Never mount or dismount while machine is moving
    - d. Never disengage or remove safety devices
    - e. Never permit riders on equipment
    - f. Be sure all bystanders are clear before starting operations
    - g. Know and respond to hand signals given by signal person
    - h. Use extreme caution on slopes and grades
    - i. Follow proper traffic patterns
11. a, c, d, f, g, i
12. b, c, f, h, i, j, l
13. Evaluated to the satisfaction of the instructor
14. Performance skills evaluated to the satisfaction of the instructor

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to operate a gradall to perform any job required. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of gradalls.
2. Match terms associated with gradalls to their correct definitions.
3. Identify attachments used on gradalls.
4. Identify instruments and controls on a gradall.
5. Select from a list safety rules related to gradalls.
6. State suggestions for effective gradall operations.
7. Select from a list items to check on a daily inspection.
8. List items to check when servicing a gradall.
9. List materials needed to service a gradall.
10. Demonstrate the ability to
    a. Start, warm up, check gauges, and test controls for performance; make final visual check.
    b. Prepare carrier for hydraulic, remote-control operation.
    c. Excavate a flat-bottomed ditch and stockpile material.
    d. Rip pavement and load a haul vehicle.
    e. Place riprap.
    f. Dress a slope, working from above.
    g. Shut down and secure equipment.

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information, assignment, and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information and assignment sheets.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Provide alternate jobs if job sheets are not practical.

   G. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment Sheet #1--List Materials Needed to Service a Gradall

   E. Answers to assignment sheet

   F. Job sheets

      1. Job Sheet #1--Start, Warm Up, Check Gauges, and Test Controls for Performance; Make Final Visual Check

      2. Job Sheet #2--Prepare Carrier for Hydraulic, Remote-Control Operation

      3. Job Sheet #3--Excavate a Flat-Bottomed Ditch and Stockpile Material

      4. Job Sheet #4--Rip Pavement and Load a Haul Vehicle

      5. Job Sheet #5--Place Riprap

      6. Job Sheet #6--Dress a Slope, Working from Above

      7. Job Sheet #7--Shut Down and Secure Equipment

   G. Test

   H. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. Nichols, H.L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

B. *The Drott*. Racine, Wisconsin: Drott Construction Equipment, Division of JI Case, n.d.

C. *300-Hydro-Scopic Operators Manual.* Winona, Minnesota: Warner & Swasey Company, 1973.

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

INFORMATION SHEET

I. Uses of gradalls (Figure 1)

A. Cleaning ditches

B. Side sloping

C. Fine grading

D. Placing riprap

E. Ripping up pavement

FIGURE 1

II. Terms and definitions

A. Side slope--Sides of ditch that form a natural or artificial incline

B. Riprap--Heavy stones placed on slope or at water's edge to prevent soil erosion

C. Curl bucket--To tilt bucket

D. Stockpile--Material dug and piled for future use

E. Fulcrum--Pivot point or point of support on which lever turns when raising or moving something

INFORMATION SHEET

F. Slope--Ground that forms a natural or artificial incline

G. Angle of repose--Greatest angle above the horizontal plane at which material will lie without sliding

H. Spoil--Dirt, rock, or material that is removed from a ditch

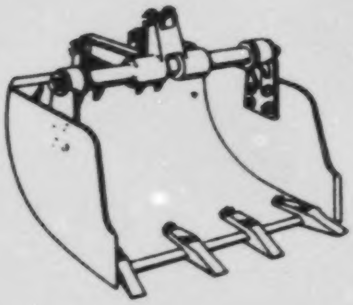
I. Chock--To block or secure

III. Attachments used on gradalls (Figures 2-10)

(NOTE: Most of these attachments are made in various sizes.)

A. Excavating bucket

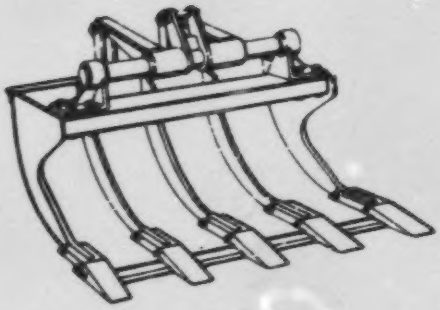
FIGURE 2



Used with permission of the Warner & Swasey Company.

B. Pavement removal bucket

FIGURE 3



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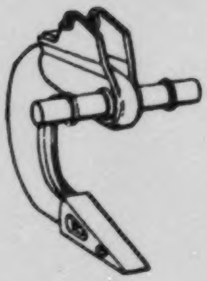
INFORMATION SHEET

C. Ripper

FIGURE 4



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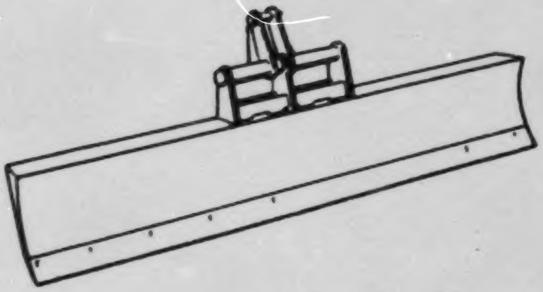
D. Scraper or grading blade

FIGURE 5



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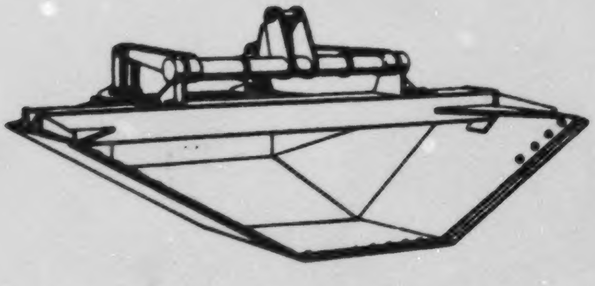
E. Formed ditch-digging bucket (V-type)

FIGURE 6



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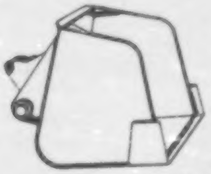
INFORMATION SHEET

F. Push-type rehandling bucket

FIGURE 7



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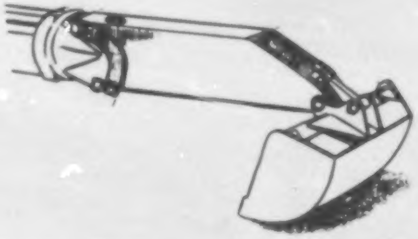
G. Boom extension

FIGURE 8



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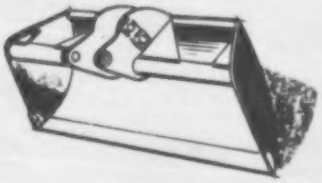
H. Ditch-cleaning bucket

FIGURE 9



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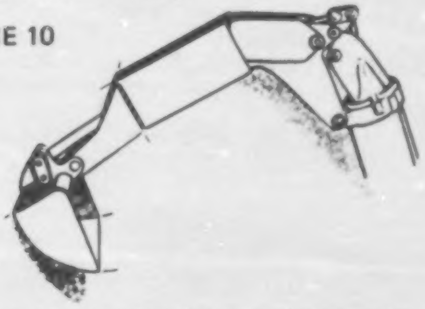
I. Material-unloading extension

FIGURE 10



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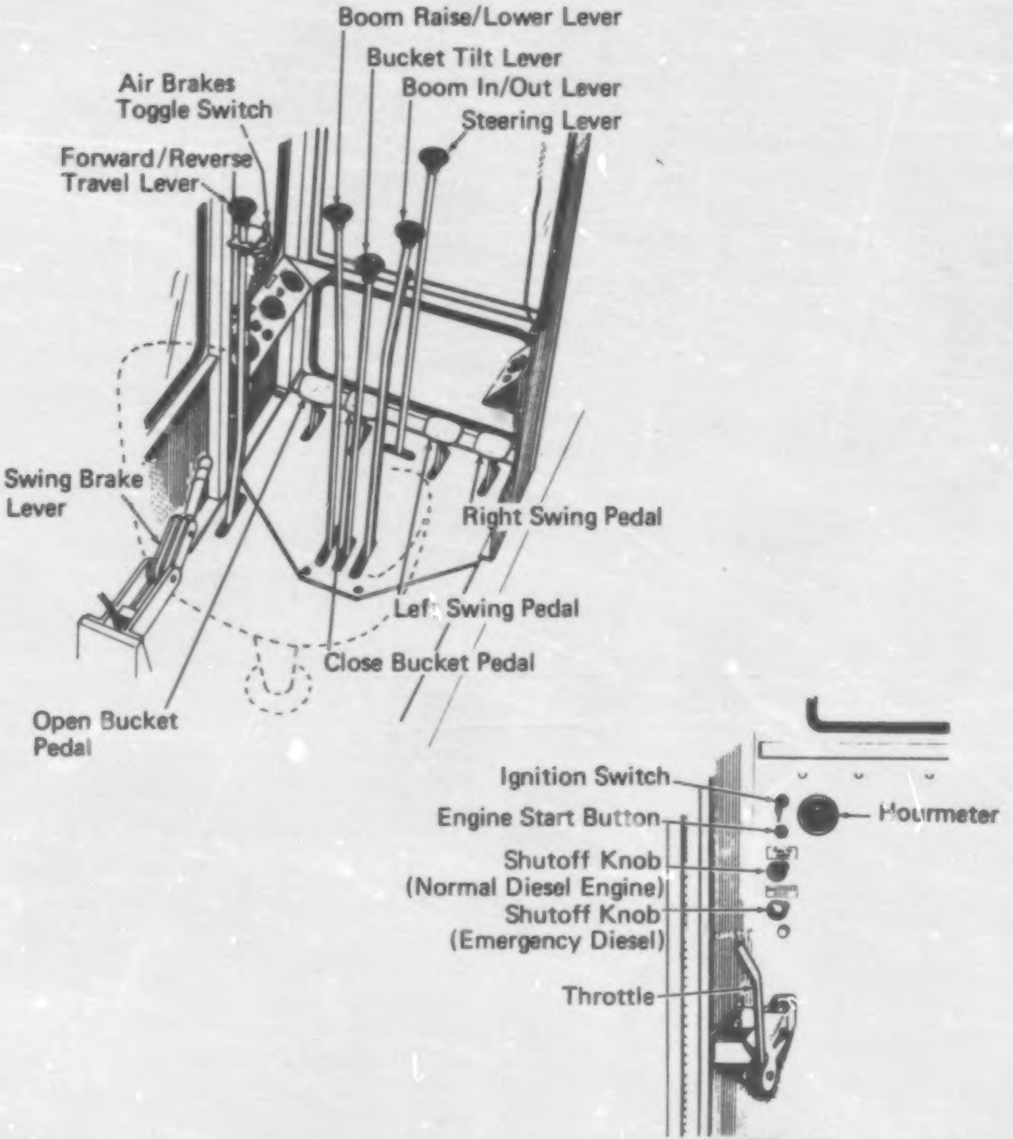
INFORMATION SHEET

IV. Instruments and controls on a gradall (Figures 11 and 12)

A. Operator's cab

FIGURE 11


Boom Raise/Lower Lever
Bucket Tilt Lever
Air Brakes Toggle Switch
Boom In/Out Lever
Steering Lever
Forward/Reverse Travel Lever
Swing Brake Lever
Right Swing Pedal
Left Swing Pedal
Close Bucket Pedal
Open Bucket Pedal
Ignition Switch
Engine Start Button
Hourmeter
Shutoff Knob (Normal Diesel Engine)
Shutoff Knob (Emergency Diesel)
Throttle

(NOTE: These controls are located on back of panel of upper cab.)

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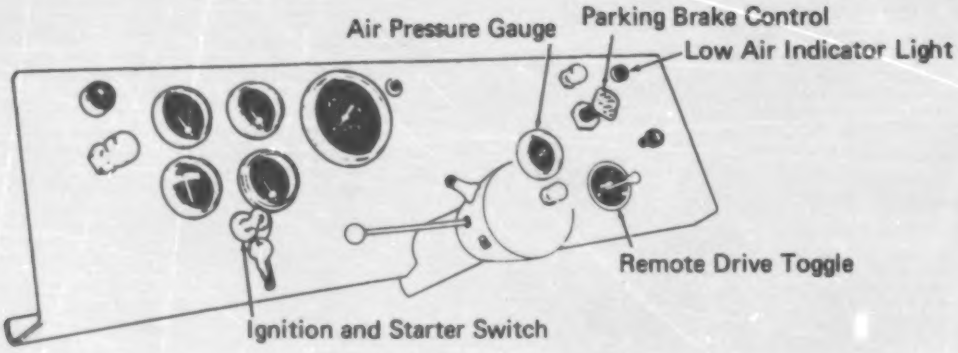
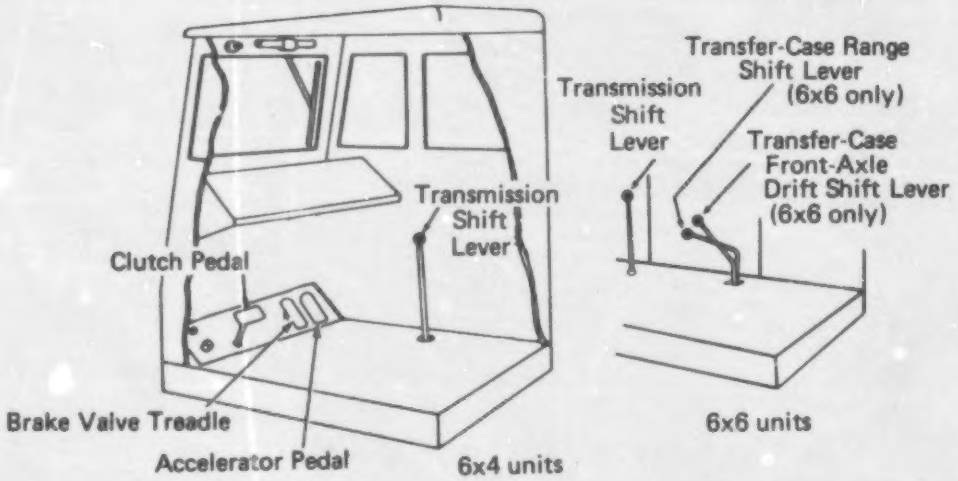
INFORMATION SHEET

B. Carrier cab

FIGURE 12


Air Pressure Gauge
Parking Brake Control
Low Air Indicator Light
Remote Drive Toggle
Ignition and Starter Switch


Transfer-Case Range Shift Lever (6x6 only)
Transmission Shift Lever
Transfer-Case Front-Axle Drift Shift Lever (6x6 only)
Transmission Shift Lever
Clutch Pedal
Brake Valve Treadle
Accelerator Pedal
6x4 units
6x6 units

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INFORMATION SHEET

V. Safety rules related to gradalls

- A. Use extreme caution around other equipment and people
- B. Be sure boom and bucket are resting on ground or in boom cradle when not in use
- C. Keep steps and deck area clean
- D. Before operating, check for proper functioning of all controls
- E. Never move machine until area is clear
- F. Check dimensions of any possible obstruction before attempting to travel with unit
- G. Use extreme caution when operating near low trees or utility lines
- H. Always place boom in boom cradle when traveling

  (CAUTION: Secure inside boom by chocking it.)

- I. When operating on roads or streets, always use warning signs, safety signals, and proper control procedures

VI. Suggestions for effective gradall operations

- A. Set up work cycle so that it will be as short as possible
- B. Keep transport distances as short as possible
- C. Use remote control as often as possible to keep from changing cabs
- D. Start raising boom so that bucket reaches dumping height at the time it arrives at the dump area
- E. Curl bucket close to boom to prevent spillage when loading trucks
- F. Keep machine clean
- G. Have equipment serviced regularly

VII. Items to check on a daily inspection

(NOTE: Deficiencies should be noted on paper.)

- A. Possible broken, worn, or missing parts, and leaks
- B. Engine oil level
- C. Engine coolant level

INFORMATION SHEET

- D. Fuel level and fuel pump sediment bowl (where applicable)
- E. Torque converter fluid level
- F. Hydraulic reservoir fluid level
- G. Battery electrolyte level
- H. Transmission fluid level
- I. Tire condition and pressure
- J. Exhaust system
- K. Air cleaner
- L. Brakes
- M. Wires, connections, and insulation
- N. Drive belts
- O. Safety devices
- P. Grease fittings
- Q. Cleanliness of equipment
- R. Windshields and wipers
- S. Upper revolving frame
- T. Boom and attachments
- U. Proper functioning of gauges and controls

VIII. Items to check when servicing a gradall (Assignment Sheet #1)

(NOTE: Follow manufacturer's specifications and recommendations when servicing gradalls.)

- A. Possible broken, worn, or missing parts, and leaks
- B. Engine oil level, filter, lines, and hose
- C. Engine coolant level, radiator cap, hose, and radiator

  (CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)
- D. Fuel level, fuel filters, and sediment bowl (where applicable)
- E. Hydraulic fluid level

INFORMATION SHEET

F. Battery electrolyte level, cables, and connections

(NOTE: Keep sparks and fire away from battery.)

G. Transmission fluid level

H. Power steering fluid level

I. Brakes and brake fluid level

J. Air cleaner filter

K. Electrical system

L. Tires

M. Drive belts

N. Windshield and wipers

O. Safety devices

P. Upper revolving components

Q. Grease fittings

R. Boom and attachments

S. Proper operation of gauges and controls

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

ASSIGNMENT SHEET #1--LIST MATERIALS NEEDED TO SERVICE A GRADALL

NAME________________________________ SCORE______________

List materials needed to perform service on a gradall. Use the Information Sheet in this unit for reference.

A. ________________________________

B. ________________________________

C. ________________________________

D. ________________________________

E. ________________________________

F. ________________________________

G. ________________________________

H. ________________________________

I. ________________________________

J. ________________________________

K. ________________________________

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

(NOTE: These are suggested answers. Instruct students to follow manufacturer's recommendations when servicing equipment.)

A. New parts when necessary

B. Engine oil

C. Engine coolant

D. Fuel

E. Hydraulic fluid

F. Electrolyte or water

G. Transmission fluid

H. Power steering fluid

I. Brake fluid

J. Cleaning solvent

K. Lubricating grease

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

JOB SHEET #1--START, WARM UP, CHECK GAUGES, AND TEST CONTROLS FOR PERFORMANCE; MAKE FINAL VISUAL CHECK

I. Equipment--Gradall (Figure 13)

FIGURE 13

II. Procedure

(NOTE: Be sure boom is in cradle position.)

A. Check controls to be sure that they are all in neutral position

B. Set throttle to one quarter (1/4) open and engage starter

C. Check all gauges for proper operating pressures and temperatures

D. Allow engine to warm up

E. Release parking brake

F. Manipulate controls to move forward, reverse, and turn

G. Manipulate controls to set outriggers

H. Manipulate controls to lift boom clear of cradle and cab

I. Manipulate controls to telescope and roll boom

J. Manipulate controls to swing and move boom up and down

JOB SHEET #1

K. Manipulate controls to curl bucket forward and backward

L. Manipulate controls to lower boom over cradle

M. Manipulate controls to lower boom into cradle position

N. Check controls to be sure that each is in neutral position

O. Dismount machine, using steps and grab irons

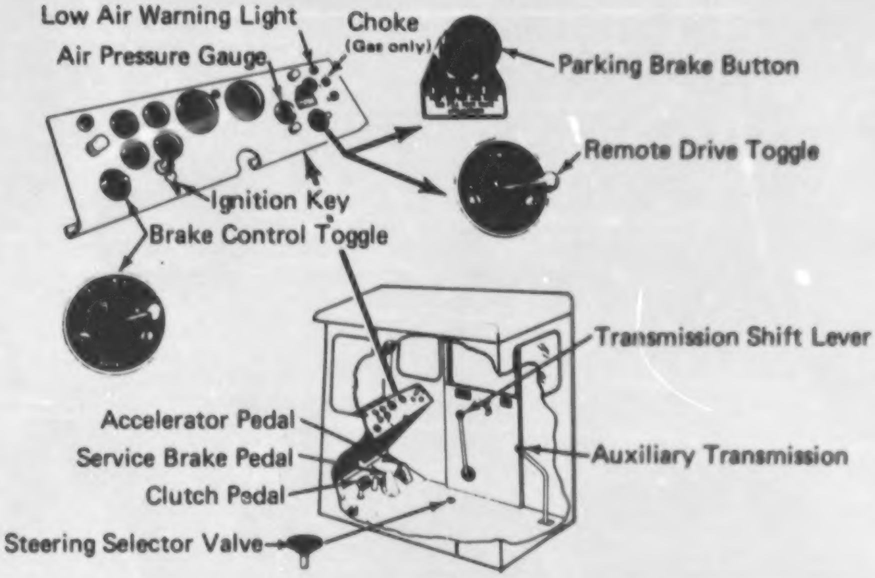
P. Make final visual check

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

JOB SHEET #2--PREPARE CARRIER FOR HYDRAULIC, REMOTE-CONTROL OPERATION

I. Equipment--Gradall (Figure 14)

FIGURE 14


Low Air Warning Light
Choke
(Gas only)
Air Pressure Gauge
Parking Brake Button
Remote Drive Toggle
Ignition Key
Brake Control Toggle
Transmission Shift Lever
Accelerator Pedal
Service Brake Pedal
Auxiliary Transmission
Clutch Pedal
Steering Selector Valve

Used with permission of the Badger Construction Equipment Company.

II. Procedure

A. Start carrier engine, depress clutch pedal and shift transfer case lever (auxiliary transmission) into desired range

(NOTE: Place in low range, by pulling lever back, for maximum pull power at reduced speed; place into high range, by pushing lever forward, for increased speed at reduced pull power.)

B. Shift carrier transmission lever into selected gear

(NOTE: Use first gear for power; use second and third gears for speed.)

C. Set remote drive toggle lever to "IN" by moving toggle lever to the left

(NOTE: Clutch pedal will automatically depress, disengaging clutch and shifting to drive position.)

JOB SHEET #2

D. Set cab-controlled brake toggle to "locked" position by moving toggle lever to the left

E. Shut down carrier engine by turning key to left in vertical position

F. Set parking brake by pulling button up

G. Pull steering selector valve "up"

(CAUTION: Be very careful not to press steering selector knob down when leaving cab because this could result in serious damage to front steering mechanism.)

H. Proceed with remote operation from upper cab

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

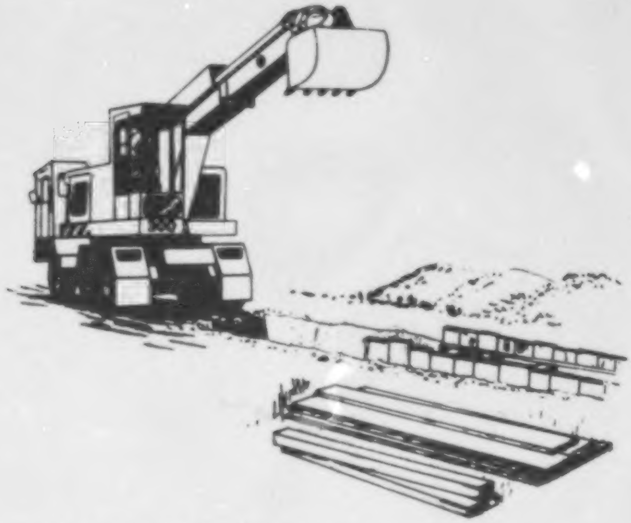
JOB SHEET #3--EXCAVATE A FLAT-BOTTOMED DITCH AND STOCKPILE MATERIAL

I. Equipment (Figure 15)

A. Gradall

B. Bucket attachment

FIGURE 15



Used with permission of the Badger Construction Equipment Company.

II. Procedure

A. Swing machine and extend boom until bucket is over spot where excavation is to start

B. Lower bucket to digging position

(NOTE: Start first few passes with teeth at a 45° angle to ground.)

C. Curl bucket inward, while retracting boom, until bucket is full

D. Curl bucket inward to closed position

E. Raise boom

F. Swing and extend boom over desired spot of stockpile

JOB SHEET #3

G. Curl bucket outward to dump

(NOTE: As material stacks up on stockpile, boom height must increase to allow for dumping.)

H. Swing boom back to digging area

I. Lower and extend boom to digging position

J. Repeat pass to deepen and lengthen ditch

(NOTE: This machine can be moved by remote controls in operator's cab.)

K. Continue procedure until entire ditch is completed

(NOTE: Use shoring when digging deep ditches.)

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

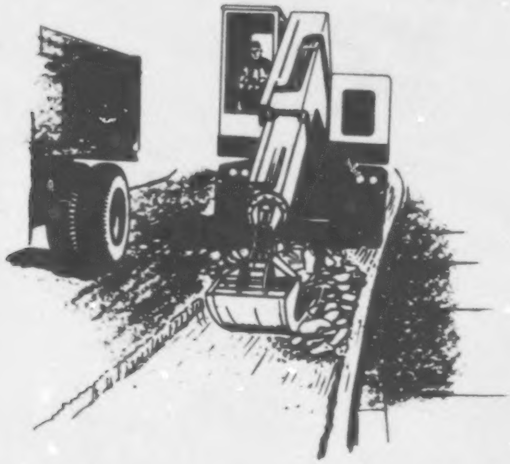
JOB SHEET #4—RIP PAVEMENT AND LOAD A HAUL VEHICLE

I. Equipment (Figure 16)

A. Gradall

B. Pavement removal bucket attachment

FIGURE 16



Used with permission of the Badger Construction Equipment Company.

II. Procedure

A. Swing machine and extend boom until bucket is over spot where digging is to start

(NOTE: Pavement at starting point must have a vertical edge or have been prebroken by a hydraulic ram or pavement breaker.)

B. Lower bucket to digging position

C. Position bucket in a level, or slightly inward, position with teeth under pavement edge

(NOTE: Use the boom-in and tool action to develop breakout pressure.)

D. Curl bucket inward to raise and break pavement

(NOTE: The surface of the ground under the pavement will act as a fulcrum to aid the teeth in prying up and breaking pavement.)

JOB SHEET #4

E. Repeat process, repositioning boom and bucket to break up and dislodge several square feet of pavement

F. Remove broken chunks by lowering boom and bucket to starting point

(NOTE: Pin larger pieces of pavement against bottom of boom when swinging to dump.)

G. Extend boom, and lower bucket to digging position, teeth down

H. To avoid digging into ground, curl bucket inward while retracting boom

I. Continue curling bucket inward until full and in closed position

J. Raise and extend boom high enough to clear side of truck bed

K. Swing, and continue to extend, until bucket is over truck bed

L. Spot bucket over center of dump bed

M. Curl bucket outward gradually to dump load

(CAUTION: To avoid damage to truck and truck bed, do not dump from extreme height.)

N. Swing bucket back to digging area

O. Retract and lower boom to digging position

P. Continue breaking and loading procedures until job is completed

(CAUTION: Care must be taken to avoid loading large heavy chunks of pavement on top of load near tailgate of truck.)

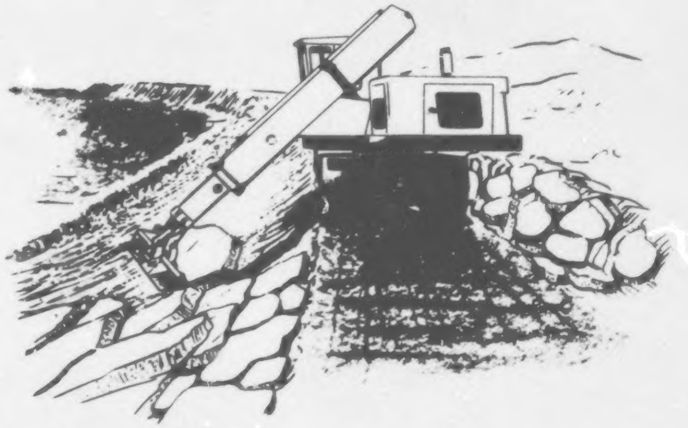
GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

JOB SHEET #5--PLACE RIPRAP

I. Equipment and material (Figure 17)

- A. Gradall
- B. Bucket attachment without teeth
- C. Stockpile of riprap

FIGURE 17



Used with permission of the Badger Construction Equipment Company.

II. Procedure

- A. Swing machine and extend boom until bucket is over stockpile
- B. Lower bucket to back edge of stockpile, retract boom (to pull bucket forward) and at same time slowly curl bucket inward
- C. Continue curling bucket inward while retracting boom until bucket fills
- D. Curl bucket inward to closed position
- E. Raise boom
- F. Swing boom over bank slope; start lowering boom after top of slope is cleared
- G. Stop swing in line with point where riprap is to start

JOB SHEET #5

H. Extend boom forward to toe of slope

I. Lower boom to angle of repose with slope

(NOTE: Boom height must be judged to allow cutting edge of bucket to be equal to the desired depth of riprap when bucket is pointed down.)

J. Curl bucket outward until rock starts falling from bucket and builds from ground to bottom edge of bucket

K. Retract boom, adjusting curl of bucket, to assure even depth of riprap

L. Raise boom when bucket is empty and swing back to stockpile

M. Extend boom while curling bucket slighty outward

N. Lower bucket to back edge of stockpile, retract boom slowly (to pull bucket forward) and at same time slowly curl bucket inward

O. Continue procedure, laying widths of riprap side by side from toe to top of slope, until slope face is evenly covered

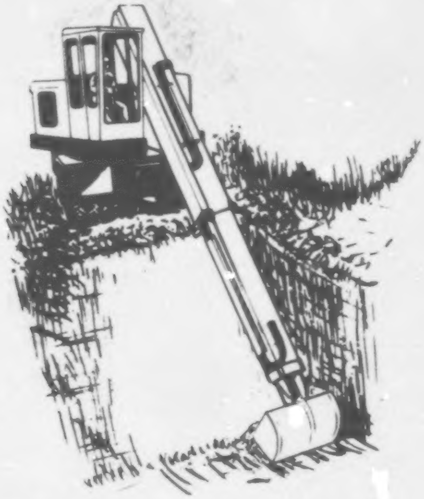
GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

JOB SHEET #6--DRESS A SLOPE, WORKING FROM ABOVE

I. Equipment (Figure 18)

- A. Gradall
- B. Bucket attachment without teeth

FIGURE 18



Used with permission of the Badger Construction Equipment Company.

II. Procedure

- A. Swing machine and extend boom to clear top of slope
- B. Lower and extend boom down the angle of repose
- C. Curl bucket inward or outward until it is level with ground

  (NOTE: By placing the bucket level on the ground, accuracy is controlled by the down pressure of the boom.)

- D. Lower boom until bucket rests on the ground
- E. Retract boom
- F. Raise and lower boom while retracting to keep bucket gently engaged in the material

  (NOTE: Raising and lowering is necessary when angle of repose does not match boom angle.)

JOB SHEET #6

G. Curl bucket inward quickly when bucket clears top of slope

H. Curl bucket completely inward to closed position to trap excess spoil picked up from slope

I. Raise and extend boom

J. Swing machine away from slope, and curl bucket outward to dump spoil over a broad area

K. Swing machine back toward top of slope while curling bucket into level position

L. Lower and extend boom down the angle of repose

M. Move machine so that bucket can be placed to overlap one quarter (1/4) of last pass

(NOTE: Use remote control to move machine.)

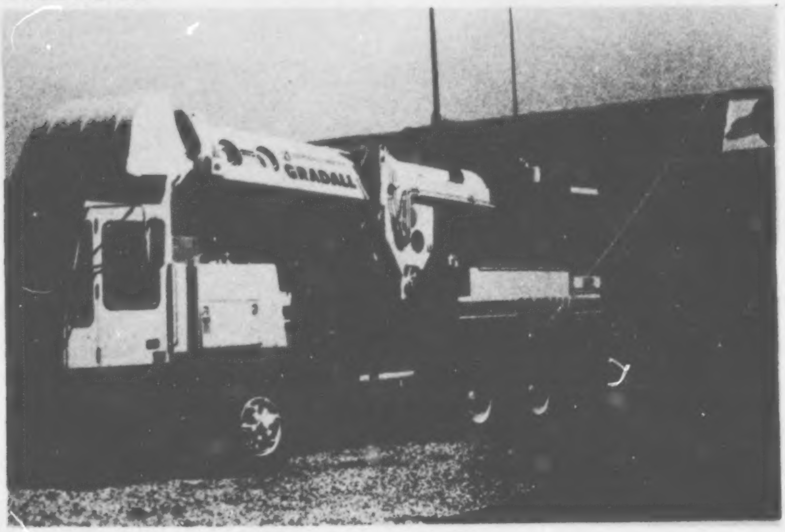
N. Continue travelling along ditch and dressing slope until job is completed

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

JOB SHEET #7--SHUT DOWN AND SECURE EQUIPMENT

I. Equipment--Gradall (Figure 19)

FIGURE 19



II. Procedure

A. Move machine to parking area

B. Park as near level as possible, away from any trenching operation

C. Place boom in cradle

D. Place all controls in neutral

E. Cool down engine

F. Turn engine off

G. Lock brakes

H. Dismount machine, using steps and grab irons

I. Make a walk-around check for worn, broken, or missing parts, and leaks

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

TEST

NAME ________________________ SCORE ____________

1. List uses of gradalls.

   a. ________________________

   b. ________________________

   c. ________________________

   d. ________________________

   e. ________________________

2. Match terms associated with gradalls to their correct definitions. Write the correct numbers in the blanks.

   _____a. Sides of ditch that form a natural or artificial incline

   _____b. Heavy stones placed on slope or at water's edge to prevent soil erosion

   _____c. To tilt bucket

   _____d. Material dug and piled for future use

   _____e. Pivot point or point of support on which lever turns when raising or moving something

   _____f. Ground that forms a natural or artificial incline

   _____g. Greatest angle above the horizontal plane at which material will lie without sliding

   _____h. Dirt, rock, or material that is removed from a ditch

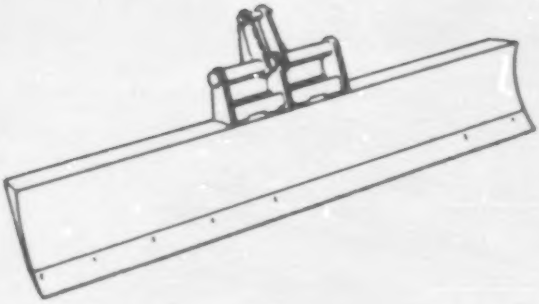
   _____i. To block or secure

   1. Stockpile
   2. Angle of repose
   3. Side slope
   4. Curl bucket
   5. Fulcrum
   6. Spoil
   7. Riprap
   8. Slope
   9. Chock

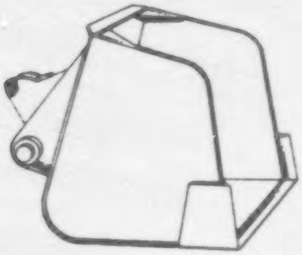
TEST

3. Identify attachments used on gradalls. Write the correct names in the blanks.

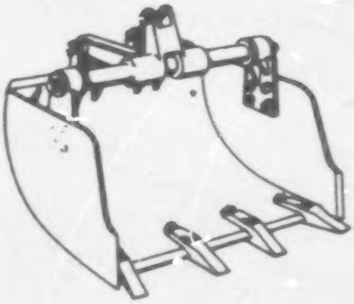
Excavating bucket
Pavement removal bucket
Ripper
Ditch-cleaning bucket
Material-unloading extension
Scraper or grading blade
Formed ditch-digging bucket (V-type)
Push-type rehandling bucket
Boom extension



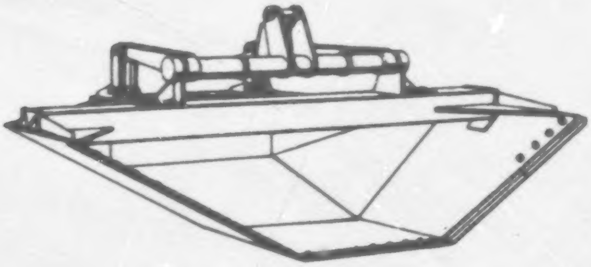
a. ______________________



b. ______________________

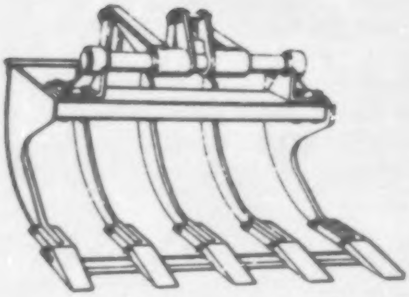


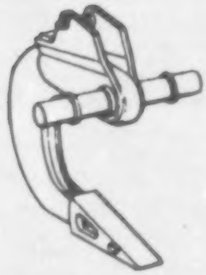
c. ______________________



d. ______________________

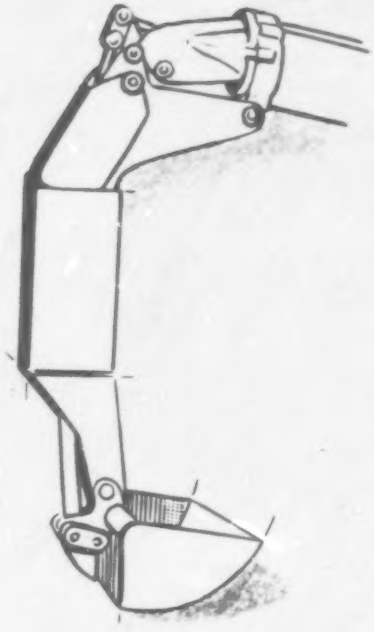
TEST

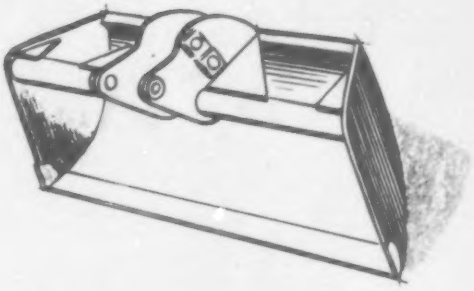




e. ______________________

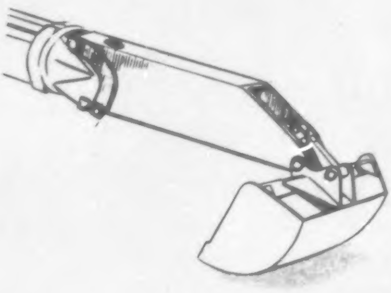
f. ______________________





g. ______________________

h. ______________________



i. ______________________

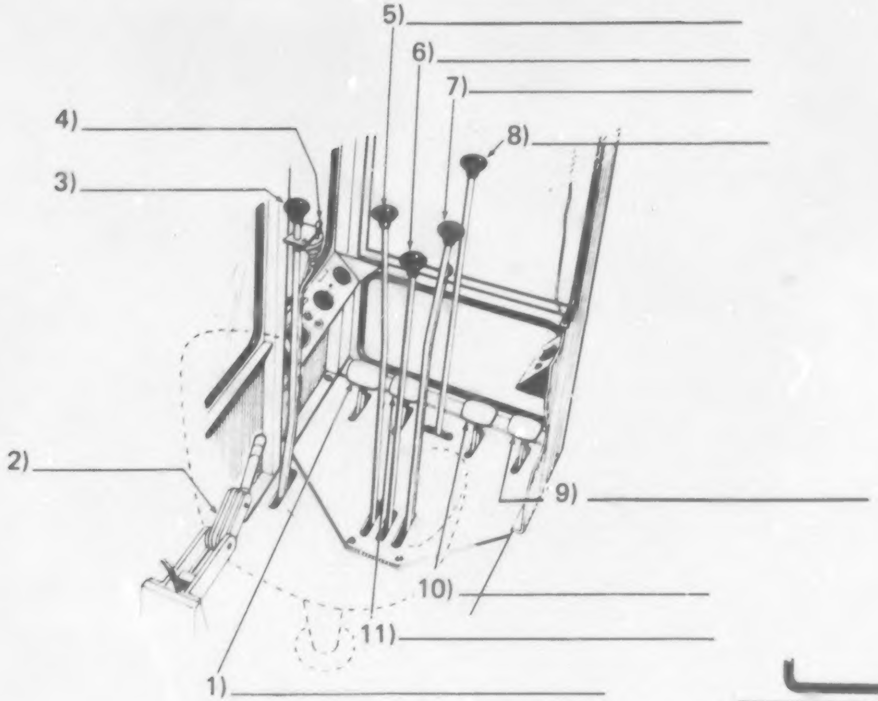
TEST

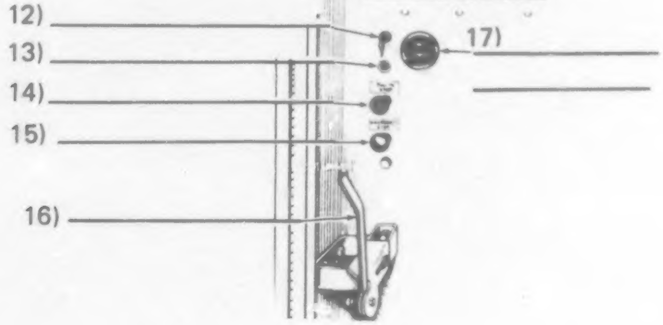
4. Identify instruments and controls on a gradall. Write the correct names in the blanks.

   a. Operator's cab

Close bucket pedal
Left swing pedal
Open bucket pedal
Swing brake lever
Right swing pedal
Shutoff knob (normal diesel engine)
Boom in/out lever
Forward/reverse travel lever

Boom raise/lower lever
Ignition switch
Bucket tilt lever
Hourmeter
Air brakes toggle switch
Steering lever
Throttle
Shutoff knob (emergency diesel)

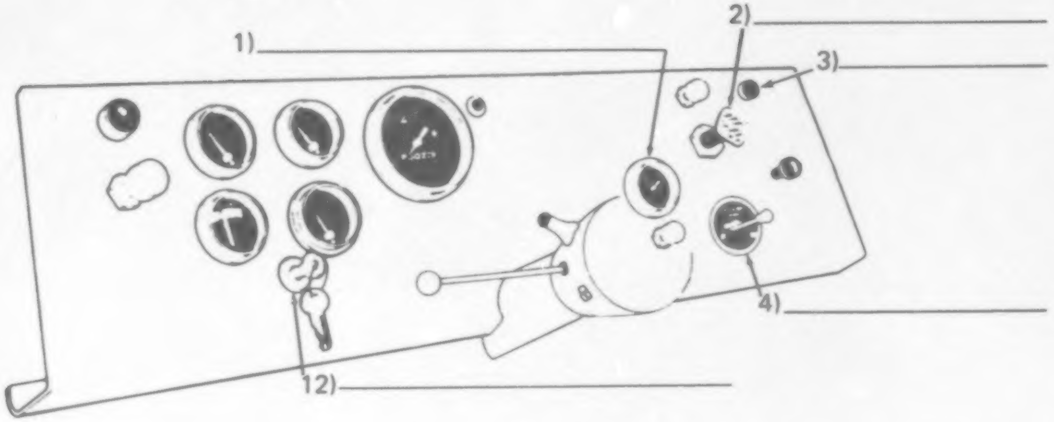


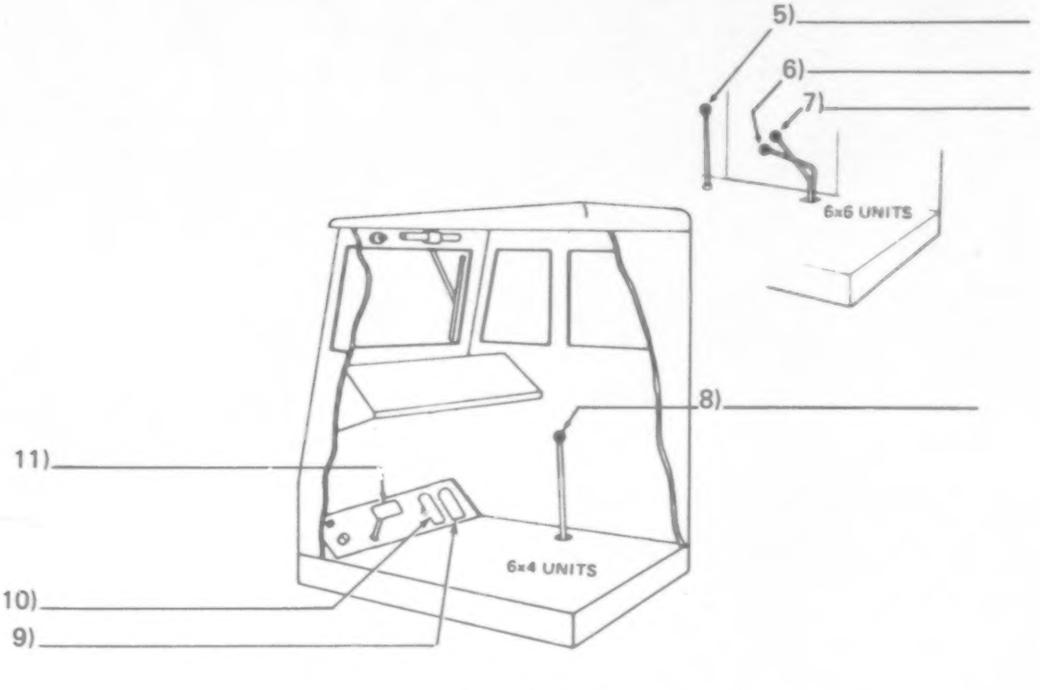


TEST

b. Carrier cab

- Low air indicator light
- Ignition and starter switch
- Accelerator pedal
- Transmission shift lever
- Transfer-case front-axle drift shift lever
- Transfer-case range shift lever
- Air pressure gauge
- Brake valve treadle
- Clutch pedal
- Remote drive toggle
- Parking brake control




5)
6)
7)
6x6 UNITS
8)
11)
6x4 UNITS
10)
9)

TEST

5. Select from the following list safety rules related to gradalls. Write an "X" in the blank before each correct answer.

______a. Use extreme caution when operating near low trees or utility lines

______b. Never move machine until area is clear

______c. Always travel with boom over the rear

______d. Keep steps and deck area clean

______e. Use outriggers only when hoisting heavy loads

______f. Use extreme caution around other equipment and people

______g. Disconnect safety signals to keep noise down

______h. Be sure boom and bucket are resting on ground or in boom cradle when not in use

______i. Before operating, check for proper functioning of all controls

6. State five suggestions for effective gradall operations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

7. Select from the following list items to check on a daily inspection. Write an "X" in the blank before each correct answer.

______a. Possible broken, worn, or missing parts, and leaks

______b. Hydraulic reservoir fluid level

______c. Fuel level and fuel pump sediment bowl (where applicable)

______d. Differential gear box

______e. Tire condition and pressure

______f. Brake linings

______g. Engine oil level

______h. Air cleaner

TEST

_____ i. Grease

_____ j. Travel assembly

_____ k. Boom and attachments

8. List ten items to check when servicing a gradall.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

   f. ______________________________

   g. ______________________________

   h. ______________________________

   i. ______________________________

   j. ______________________________

(NOTE: Test questions 9 and 10 list the assignment and job sheets. These are an important part of this test. If they have not been completed, check with your instructor.)

9. List materials needed to service a gradall.

10. Demonstrate the ability to

    a. Start, warm up, check gauges, and test controls for performance; make final visual check.

    b. Prepare carrier for hydraulic, remote-control operation.

    c. Excavate a flat-bottomed ditch and stockpile material.

    d. Rip pavement and load a haul vehicle.

    e. Place riprap.

    f. Dress a slope, working from above.

    g. Shut down and secure equipment.

GRADALLS
(ALL-PURPOSE EXCAVATORS)
UNIT I

ANSWERS TO TEST

1. a. Cleaning ditches
   b. Side sloping
   c. Fine grading
   d. Placing riprap
   e. Ripping up pavement
2. a. 3
   b. 7
   c. 4
   d. 1
   e. 5
   f. 8
   g. 2
   h. 6
   i. 9
3. a. Scraper or grading blade
   b. Push-type rehandling bucket
   c. Excavating bucket
   d. Formed ditch-digging bucket (V-type)
   e. Pavement removal bucket
   f. Ripper
   g. Ditch-cleaning bucket
   h. Material-unloading extension
   i. Boom extension
4. a. 1) Open bucket pedal
      2) Swing brake lever
      3) Forward/reverse travel lever
      4) Air brakes toggle switch

ANSWERS TO TEST

5) Boom raise/lower lever
6) Bucket tilt lever
7) Boom in/out lever
8) Steering lever
9) Right swing pedal
10) Left swing pedal
11) Close bucket pedal
12) Ignition switch
13) Engine start button
14) Shutoff knob (normal diesel engine)
15) Shutoff knob (emergency diesel)
16) Throttle
17) Hourmeter

b. 1) Air pressure gauge
2) Parking brake control
3) Low air indicator light
4) Remote drive toggle
5) Transmission shift lever
6) Transfer-case range shift lever
7) Transfer-case front-axle drift shift lever
8) Transmission shift lever
9) Accelerator pedal
10) Brake valve treadle
11) Clutch pedal
12) Ignition and starter switch

ANSWERS TO TEST

5. a, b, d, f, h, i

6. Answer should include any five of the following

   a. Set up work cycle so that it will be as short as possible

   b. Keep transport distances as short as possible

   c. Use remote control often to keep from changing cabs

   d. Start raising boom so that bucket reaches dumping height at the time it arrives at the dump area

   e. Curl bucket close to boom to prevent spillage when loading trucks

   f. Keep machine clean

   g. Have equipment serviced regularly

7. a, b, c, e, g, h, k

8. Answer should include any ten of the following

   a. Possible broken, worn, or missing parts, and leaks

   b. Engine oil level, filter, lines, and hose

   c. Engine coolant level, radiator cap, hose, and radiator

   d. Fuel level, fuel filters, and sediment bowl (where applicable)

   e. Hydraulic fluid level

   f. Battery electrolyte level, cables, and connections

   g. Transmission fluid level

   h. Power steering fluid level

   i. Brakes and brake fluid level

   j. Air cleaner filter

   k. Electrical system

   l. Tires

   m. Drive belts

   n. Windshield and wipers

   o. Safety devices

ANSWERS TO TEST

  - p. Upper revolving components
  - q. Grease fittings
  - r. Boom and attachments
  - s. Proper operation of gauges and controls

9. Evaluated to the satisfaction of the instructor
10. Performance skills evaluated to the satisfaction of the instructor

BACKHOES
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to skillfully inspect and service a backhoe. The student should also be able to operate the backhoe efficiently and safely. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of backhoes.
2. Match terms associated with backhoes to their correct definitions.
3. State safety rules related to backhoes.
4. List types of backhoes.
5. Identify basic components of a backhoe.
6. Identify controls on a typical backhoe.
7. Select from a list types of safety and security devices that should be standard equipment on backhoes.
8. State suggestions for effective backhoe operations.
9. Select from a list items to check on a daily inspection.
10. Select from a list items to check when servicing a backhoe.
11. List equipment and materials needed to service a backhoe.
12. Demonstrate the ability to
    a. Start, warm up, check gauges, and check controls for performance; shut down machine.
    b. Perform daily inspection on a backhoe.
    c. Service a backhoe.
    d. Carry a straight line while excavating a ditch and loading a haul truck.
    e. Operate a backhoe, using a hydraulic breaker.
    f. Operate backhoe to set pipe.
    g. Set up machine on level terrain and on sloped terrain.
    h. Operate a backhoe to dig a 32' x 50' x 5' basement.

BACKHOES
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

  A. Provide students with objective sheet.

  B. Provide students with information, assignment, and job sheets.

  C. Discuss unit and specific objectives.

  D. Discuss information and assignment sheets.

  E. Demonstrate and discuss procedures outlined in job sheets.

  F. Provide students with operator's manuals and maintenance guides.

  G. Give test.

II. Instructional materials

  A. Objective sheet

  B. Suggested activities

  C. Information sheet

  D. Assignment Sheet #1--List Equipment and Materials Needed to Service a Backhoe

  E. Answers to assignment sheet

  F. Job sheets

    1. Job Sheet #1--Start, Warm Up, Check Gauges, and Check Controls for Performance; Shut Down Machine

    2. Job Sheet #2--Perform Daily Inspection on a Backhoe

    3. Job Sheet #3--Service a Backhoe

    4. Job Sheet #4--Carry a Straight Line while Excavating a Ditch and Loading a Haul Truck

    5. Job Sheet #5--Operate a Backhoe, Using a Hydraulic Breaker

    6. Job Sheet #6--Operate Backhoe to Set Pipe

    7. Job Sheet #7--Set Up Machine on Level Terrain and on Sloped Terrain

    8. Job Sheet #8--Operate a Backhoe to Dig a 32' x 50' x 5' Basement

SUGGESTED ACTIVITIES

G. Test

H. Answers to test

III. Unit references

A. *Case 780CK Loader Backhoe Operator's Manual.* Racine, Wisconsin: JI Case, n.d.

B. *Hydraulic Backhoe-Loader Manual.* Olympia, Washington: Washington State Department of Transportation, 1980.

C. Nichols, H. L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

D. *Operating Instructions, 325-H.* South Milwaukee, Wisconsin: Bucyrus-Erie Company Sales Development Department, n.d.

BACKHOES
UNIT II

INFORMATION SHEET

I. Uses of backhoes (Figure 1)

(NOTE: Basically, a backhoe is a hydraulically operated unit mounted on the back of a crawler or wheel-type tractor.)

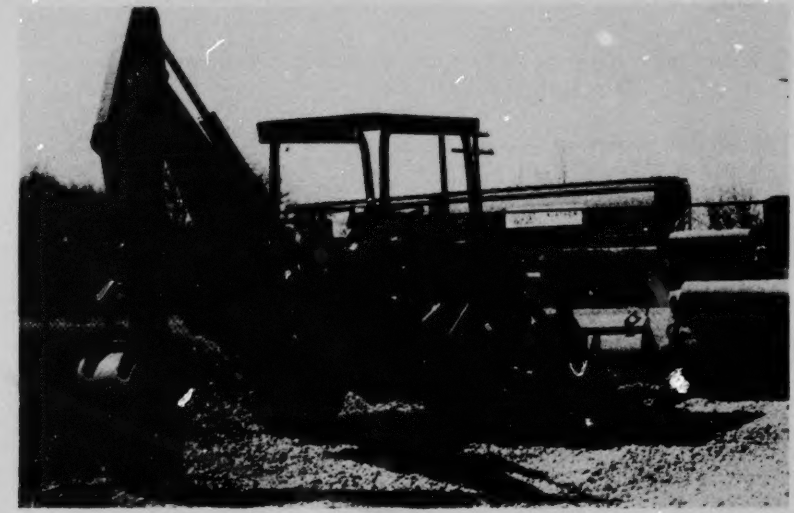
A. Digging and cleaning narrow ditches

B. Excavating small areas where it is not practical for other equipment

C. Light-duty hoisting

D. Loading trucks

FIGURE 1



II. Terms and definitions

A. Shoring--Temporary bracing to hold sides of excavation and keep them from caving in

B. Lock-up kit--Kit used to secure or make safe

C. SMV--Slow-moving vehicle

D. Curl--Rotate the bucket

E. Crowd--Process of forcing a bucket into digging; mechanism which does the forcing

INFORMATION SHEET

III. Safety rules related to backhoes

A. Do not permit anyone to stand alongside trench being excavated

B. Check all component hinge pins and their securing devices often

C. Be sure outriggers are properly extended before starting operations

D. Observe extreme caution when operating under low overhead obstructions

E. Observe extreme caution when excavating where there may be underground wires and pipes

F. Always use warning signs and proper control procedures when working on roads or streets

G. Never perform service or repairs on equipment that has not been properly blocked and secured

H. Keep bucket as close to ground as possible when transporting loads, and travel at safe operating speed

(NOTE: A careful operator is always the best insurance against an accident.)

IV. Types of backhoes

(NOTE: Term *hoe* applies to an excavating machine of the power shovel group.)

A. Crawler-type, cable-operated

B. Rubber-tired tractor-type, hydraulically operated

C. Truck-mounted, cable-operated

D. Truck-mounted, hydraulic

E. Crawler-type, hydraulically operated

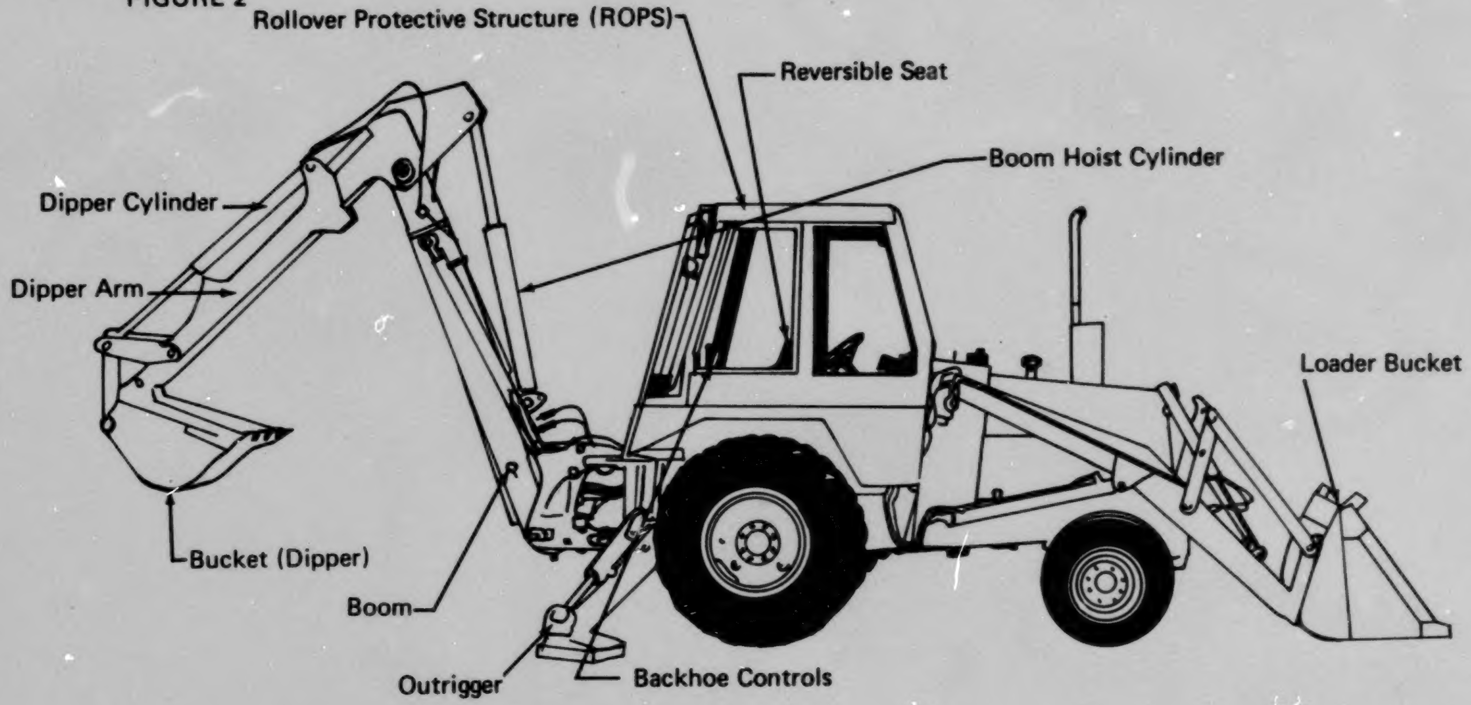
F. Multi-purpose hydraulic

G. Trenching machine with backhoe accessory

INFORMATION SHEET

V. Basic components of a backhoe (Figure 2)

FIGURE 2

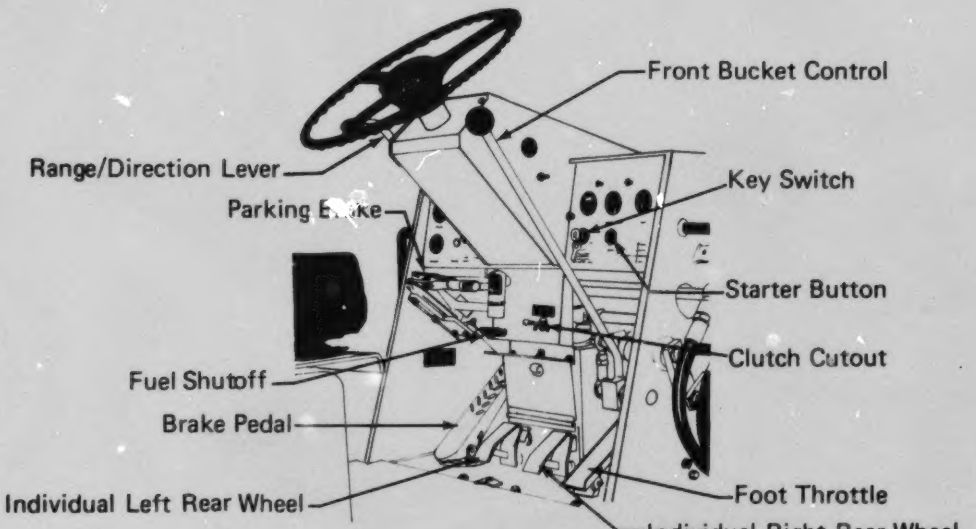

Rollover Protective Structure (ROPS)
Reversible Seat
Boom Hoist Cylinder
Dipper Cylinder
Dipper Arm
Loader Bucket
Bucket (Dipper)
Boom
Outrigger
Backhoe Controls

INFORMATION SHEET

VI. Controls on a typical backhoe (Figures 3 and 4)

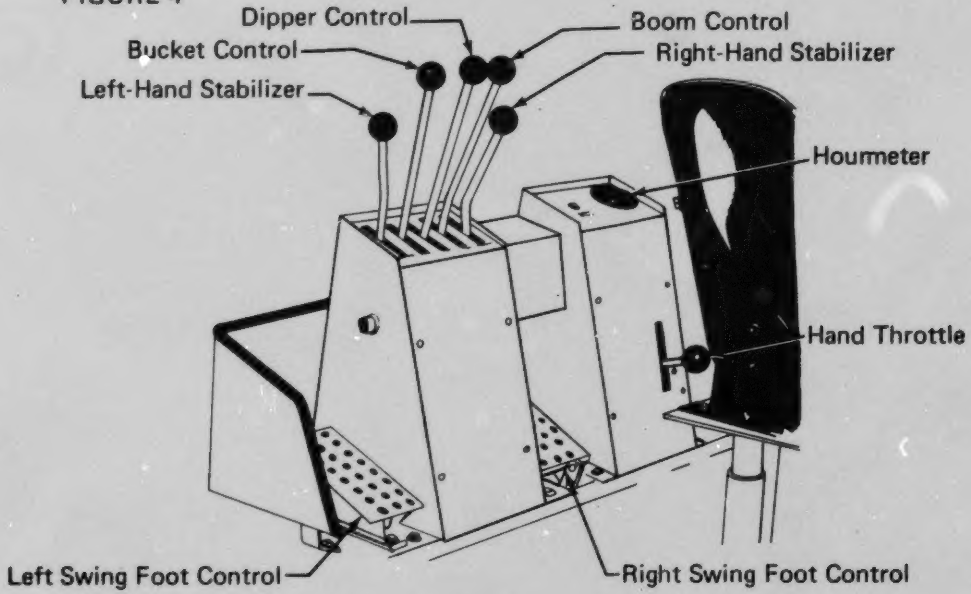
A. Tractor

FIGURE 3


Front Bucket Control
Range/Direction Lever
Key Switch
Parking Brake
Starter Button
Clutch Cutout
Fuel Shutoff
Brake Pedal
Individual Left Rear Wheel
Foot Throttle
Individual Right Rear Wheel

B. Backhoe

FIGURE 4


Dipper Control
Boom Control
Bucket Control
Right-Hand Stabilizer
Left-Hand Stabilizer
Hourmeter
Hand Throttle
Left Swing Foot Control
Right Swing Foot Control

INFORMATION SHEET

VII. Types of safety and security devices that should be standard equipment on backhoes

- A. Horn
- B. Backup lights
- C. Backup alarm
- D. Rollover protective structure
- E. SMV emblem
- F. Lock-up kit
- G. Spark-arresting muffler
- H. Brake air reservoir warning buzzer
- I. Forward/reverse safety lock
- J. Stop/taillights and flasher lights

VIII. Suggestions for effective backhoe operations

- A. Set up work cycle so that it will be as short as possible
- B. Keep transport distances as short as possible
- C. Carry bucket just high enough to clear obstacles when transporting load
- D. Start raising boom so that bucket will reach dumping height at the time it arrives at the dump area
- E. Fill truck gradually from far side to near side
- F. Work from top down and take shallow bites to fill bucket
- G. When dumping bucket, actuate crowd and bucket cylinders at same time to be ready for return cycle
- H. Pick up bucket when it is full
- I. Curl bucket close to dipper arm to prevent spilling when loading trucks
- J. Keep machine clean
- K. Service machine regularly
- L. Keep radiator free of bugs and trash during hot weather

INFORMATION SHEET

IX. Items to check on a daily inspection

(NOTE: Deficiencies should be noted on paper.)

A. Possible broken, worn, or missing parts, and leaks

B. Engine oil level

C. Radiator coolant level

D. Battery electrolyte level and battery cable connections

E. Fuel level

F. Hydraulic fluid level

G. Air cleaner

H. Wires, insulation, and connections

I. Condition and adjustment of drive belts

J. Fuel pump sediment bowl (where applicable)

K. Transmission fluid level

L. Exhaust system

M. Safety devices

N. Tires

O. Cleanliness of equipment

P. Windshield wipers and windshield (where applicable)

Q. Major components and/or accessories

R. Gauges, for normal operation

S. Controls, for proper functioning

X. Items to check when servicing a backhoe (Assignment Sheet #1)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Possible broken, worn, or missing parts, and leaks

B. Engine oil level, filter, lines, and hoses

C. Air cleaner filter (element)

INFORMATION SHEET

D. Engine coolant level, radiator cap, hose, and radiator

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Fuel level, fuel filters, and sediment bowl (where applicable)

F. Battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Exhaust system

H. Hydraulic fluid level, filters, hose, lines, fittings, and possible leaks

I. Transmission fluid level

J. Transmission pressure line filter and breather

K. Brake adjustment and condition

L. Brake master cylinder fluid level

M. Clutch for proper adjustment

N. Drive belts for tension and wear

O. Wiring, insulation, and connections

P. Grease fittings

Q. Tires, pressures, and conditions

R. Rear axle oil level

S. All safety devices

T. Windshield wipers (where applicable)

U. Major components and accessories

V. Gauges and controls, for proper functioning

BACKHOES
UNIT II

ASSIGNMENT SHEET #1--LIST EQUIPMENT AND MATERIALS NEEDED TO SERVICE A BACKHOE

NAME ______________________________ SCORE ______________

Using the Information Sheet, list materials needed to service a backhoe.

A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

E. ______________________________

F. ______________________________

G. ______________________________

H. ______________________________

I. ______________________________

J. ______________________________

K. ______________________________

L. ______________________________

BACKHOES
UNIT II

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

(NOTE: Since types of lubrication will vary due to the different types of equipment and different manufacturers, this assignment must be evaluated to the satisfaction of the instructor.)

A. Engine oil

B. Engine coolant

C. Fuel (diesel or gasoline)

D. Battery electrolyte or water

E. Hydraulic fluid

F. Transmission fluid

G. Rear axle oil

H. Air supply

I. Lubrication grease

J. Brake fluid

K. Shop rags

L. Cleaning solvent

M. Replacement parts if needed

BACKHOES
UNIT II

JOB SHEET #1--START, WARM UP, CHECK GAUGES, AND CHECK CONTROLS FOR PERFORMANCE; SHUT DOWN MACHINE

I. Equipment--Rubber-tired, tractor-type backhoe

II. Procedure

   A. Check parking brake to be sure it is set

   B. Set throttle to one quarter (1/4) open

   C. Engage starter

      (NOTE: Do not operate starter for more than 30 seconds. If engine fails to start, wait 2 minutes for starter to cool before re-engaging.)

   D. Check visually to see that all gauges are operating correctly

   E. Activate controls to warm up hydraulic fluid

   F. Manipulate controls to move forward, backward, and turn

   G. Manipulate controls to raise and lower boom

   H. Manipulate controls to swing boom left and right

   I. Manipulate controls to extend and retract bucket

   J. Manipulate controls to crowd and curl bucket

   K. Manipulate controls to extend, set, and retract outriggers

   L. Cool down engine for three to five minutes

   M. Depress brake pedal

   N. Shift range-direction lever into neutral

   O. Engage parking brake

   P. Close throttle

   Q. Shut off starter switch

   R. Make a visual walk-around check for loose, worn, or broken parts, and for leaks

BACKHOES
UNIT II

JOB SHEET #2–PERFORM DAILY INSPECTION ON A BACKHOE

I. Equipment

  A. Backhoe

  B. Tool kit

  C. Shop rags

II. Procedure

  A. Walk around equipment, inspecting for broken, worn or missing parts, and leaks

  (NOTE: Write down on paper any repairs that are needed.)

  B. Check engine oil level

  C. Check radiator coolant level

  D. Check battery electrolyte level and battery cable connections

  E. Check fuel level

  F. Check hydraulic fluid level

  G. Check air cleaner

  H. Check wires, insulation, and connections

  I. Check condition and adjustment of drive belts

  J. Check fuel pump sediment bowl (where applicable)

  K. Check transmission fluid level

  L. Check exhaust system

  M. Check all safety devices

  N. Check condition of tires

  O. Make sure equipment is clean

  P. Check windshield wipers and windshield (where applicable)

  Q. Check major components and accessories

  R. Check gauges, for normal operation

  S. Check controls, for proper functioning

BACKHOES
UNIT II

JOB SHEET #3--SERVICE A BACKHOE

I. Equipment and materials

A. Backhoe

B. Tool kit

C. Engine oil

D. Cleaning solvent

E. Engine coolant or water

F. Fuel

G. Battery electrolyte or water

H. Hydraulic fluid

I. Transmission fluid

J. Brake fluid

K. Air supply

L. Grease gun

M. Lubricating grease

N. Shop rags

O. Manufacturer's operator's guide and service manual

II. Procedure

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Visually inspect for broken, worn, or missing parts, and leaks

B. Check engine oil level, filter, lines, and hoses; add oil if necessary

C. Check air cleaner filter (element)

D. Check engine coolant level, radiator cap, hose, and radiator; add coolant if necessary

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Fill fuel tank and check fuel filters; clean sediment bowl (where applicable), if necessary

JOB SHEET #3

F. Check battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Check exhaust system

H. Check hydraulic fluid level, filters, hose, lines, fittings, and look for leaks; add fluid if necessary

I. Check transmission fluid level; fill if necessary

J. Check transmission pressure line filter and breather

K. Check brake adjustment and condition; adjust if necessary

L. Check brake master cylinder fluid level; fill if necessary

M. Check for proper adjustment of clutch; adjust if necessary

N. Check drive belts for tension and wear; adjust or replace, if necessary

O. Check wiring, insulation, and connections

P. Clean grease fittings and lubricate

Q. Check tire conditions and pressures

R. Check all safety devices

S. Check windshield wipers and clean windshield (where applicable)

T. Check major components and accessories

U. Check for proper functioning of gauges and controls

BACKHOES
UNIT II

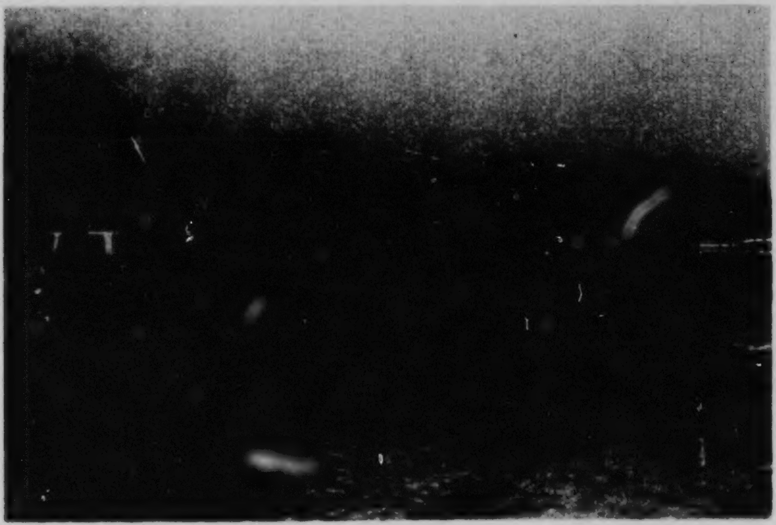
JOB SHEET #4--CARRY A STRAIGHT LINE WHILE EXCAVATING A DITCH AND LOADING A HAUL TRUCK

I. Equipment

A. Backhoe (Figure 5)

B. Haul truck

FIGURE 5



II. Procedure

A. Position backhoe in a straight line with the marked lines (usually marked with lime) of the proposed ditch

B. Position truck so that it can be loaded over the side

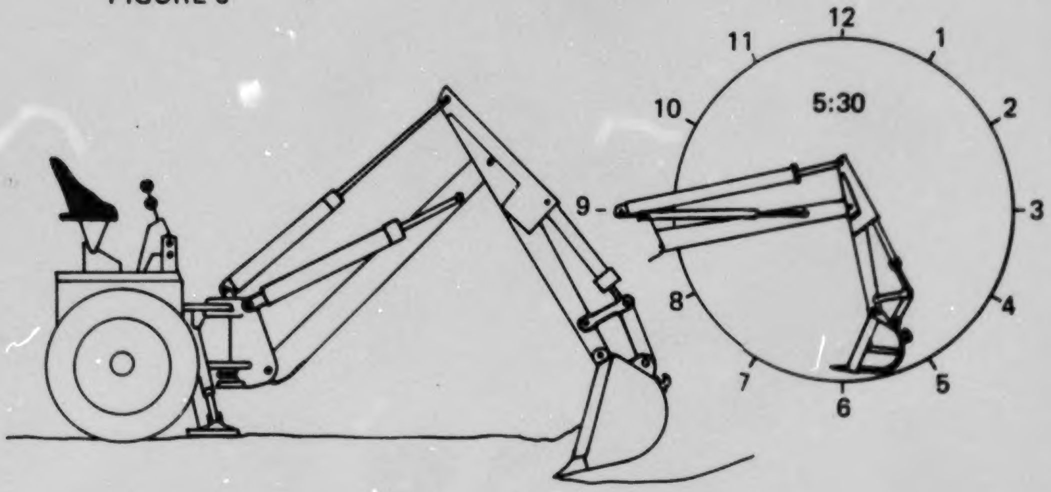
C. Lower stabilizers until wheels are off the ground

D. Lower loader bucket to the ground to provide a front stabilizer

JOB SHEET #4

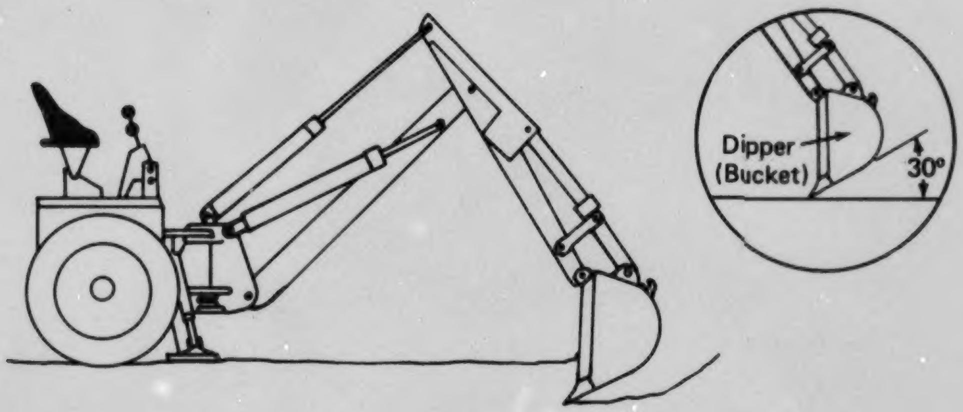
E. Engage bucket arm control to move bucket to 5:30 (Figure 6)

FIGURE 6


12
1
2
3
4
5
6
7
8
9
10
11
5:30

F. Engage bucket control to position cutting edge at about a 30-degree angle to ground (Figure 7)

FIGURE 7


Dipper
(Bucket)
30°

G. Move boom control to lower bucket to ground

(NOTE: Load bucket quickly and easily with thin slices.)

JOB SHEET #4

H. Pull bucket arm control in, and as bucket enters the material, manipulate the bucket cylinder control so that cutting edge is working parallel to ground

(NOTE: Forcing equipment reduces efficiency and durability.)

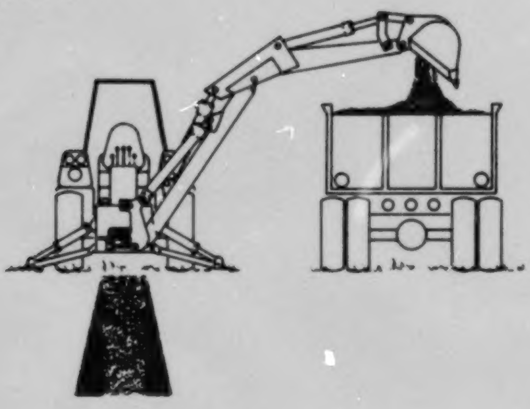
I. Raise or lower boom control slightly if bucket arm slows or stops filling the bucket

J. Pick up bucket as soon as it is full

(NOTE: As depth of ditch is reached, move backhoe, keeping in line with marked ditch line.)

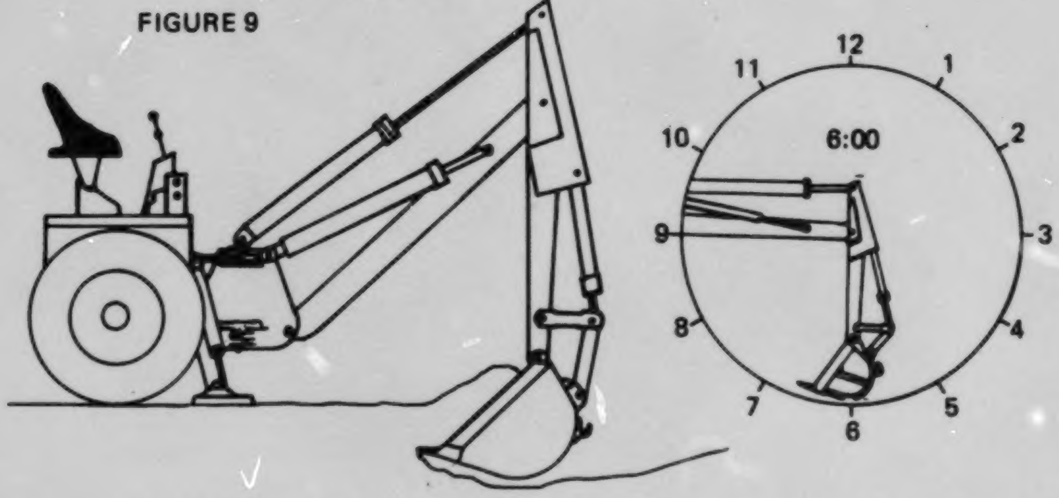
K. Raise boom control to clear cut and side of truck; swing bucket to truck and gradually spill load out of bucket to ease the strain of added weight on the truck (Figure 8)

FIGURE 8



(NOTE: Keep bucket arm at 6:00; see Figure 9.)

FIGURE 9



JOB SHEET #4

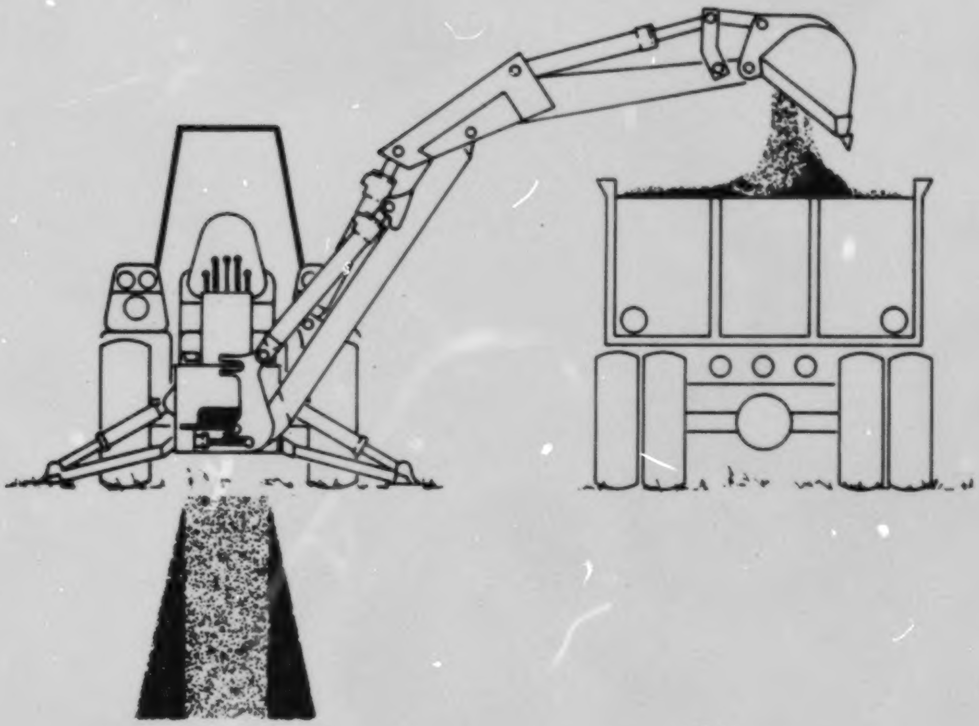
L. Actuate the bucket and bucket arm control levers at the same time for a fast, controlled dump

(NOTE: Load truck from far side to near side.)

M. Swing bucket back to cut and continue cycle until ditch is complete or until truck is loaded (Figure 10)

(NOTE: While waiting for truck, use the time to move backhoe or make adjustments, loosen dirt, or clean up corners of cut.)

FIGURE 10



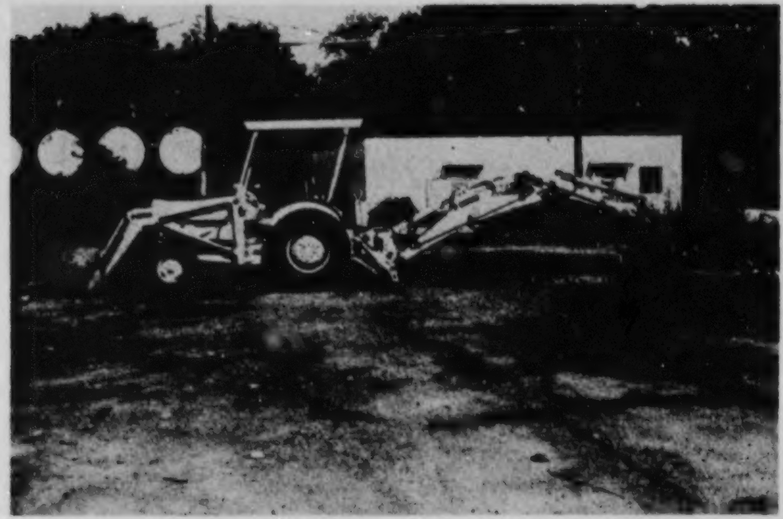
BACKHOES
UNIT II

JOB SHEET #5--OPERATE A BACKHOE, USING A HYDRAULIC BREAKER

I. Equipment

- A. Backhoe (Figure 11)
- B. Hydraulic breaker attachment

FIGURE 11



II. Procedure

- A. Mount backhoe and start engine
- B. Raise outriggers (stabilizers)
- C. Raise loader bucket
- D. Raise breaker attachment
- E. Proceed to job location
- F. Move to starting point and set up machine
- G. Lower loader bucket to the ground enough to take pressure off front tires
- H. Move to backhoe controls
- I. Lower outriggers to the ground until most of rear weight of backhoe is on the outriggers and backhoe is level

JOB SHEET #5

J. Lower breaker to the ground (Figure 12)

FIGURE 12

K. Remove swing lock pin and boom lock pin (when applicable)

L. Position breaker to start breaking up concrete

M. Use foot control to engage hammer

N. Start breaking

O. Continue breaking until area is completely broken

P. Move machine

Q. Raise breaker attachment

R. Raise outriggers

S. Raise loader bucket

(NOTE: When all of the area within reach of the backhoe is broken up, the backhoe will have to be moved far enough that the breaker can just barely reach the section already broken.)

T. Continue breaking operations until job is complete

BACKHOES
UNIT II

JOB SHEET #6--OPERATE BACKHOE TO SET PIPE

I. Equipment

A. Backhoe

B. Pipe hook or sling with sliding choker hook

C. Sections of pipe

(NOTE: Some operators prefer to use a sling rather than a pipe hook, especially when working in a trench box.)

D. Subgrade material

II. Procedure

(NOTE: After excavation of ditch it will be necessary to place subgrade material in bottom of ditch.)

A. Fill bucket with subgrade material

B. Cast out bucket to spread material

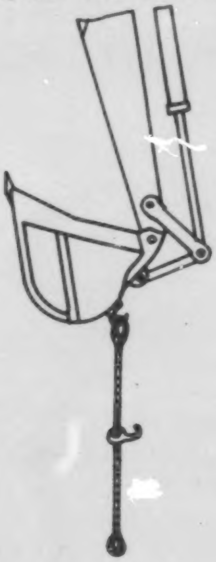
C. Drag bucket (teeth down) through ditch to help level out material and maintain grade

D. Curl bucket so that hook on bucket is in position to attach sling

E. Connect sling to bucket hook (Figure 13)

(NOTE: Pipe will be brought from stockpile to ditch location by other equipment; this will eliminate moving the backhoe in and out of ditch.)

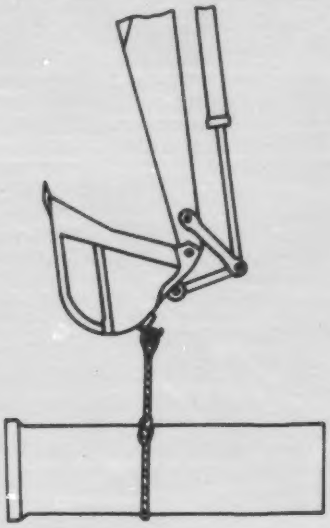
FIGURE 13



JOB SHEET #6

F. Lower boom and center over pipe so that sling can be attached (Figure 14)

FIGURE 14



G. Raise boom until slack is taken out of sling

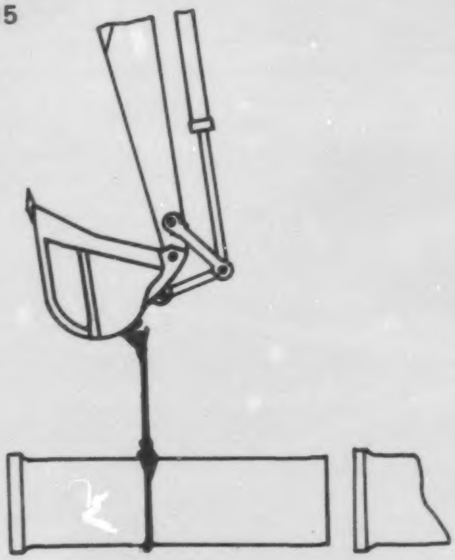
H. Continue raising boom until pipe clears all obstructions

(CAUTION: When working around power lines, maintain a safe distance at all times.)

I. Lower pipe so that it will line up with end of pipe already set (Figure 15)

(NOTE: Ground crew will help line up pipes and make the connection.)

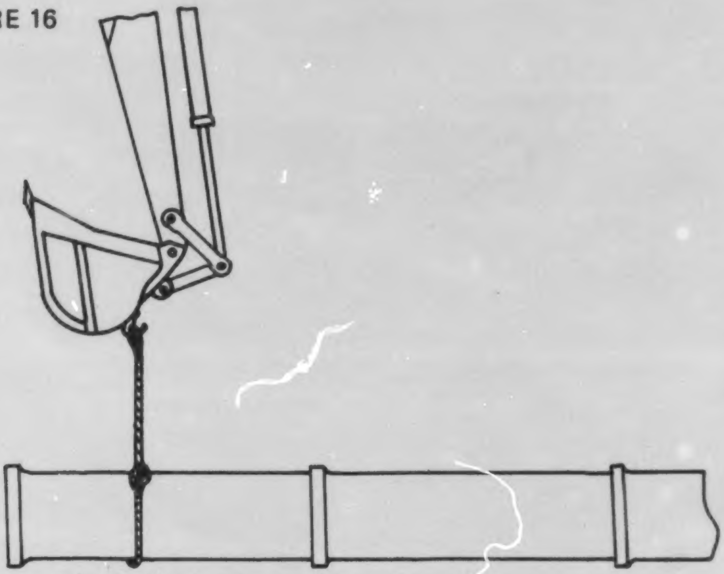
FIGURE 15



JOB SHEET #6

J. Move bucket control to roll bucket out and move pipe in place (Figure 16)

FIGURE 16



K. Lower boom slightly to put slack in sling

(NOTE: Ground crew will disconnect sling.)

L. Reposition backhoe to set next pipe

M. Continue cycle until job is complete

BACKHOES
UNIT II

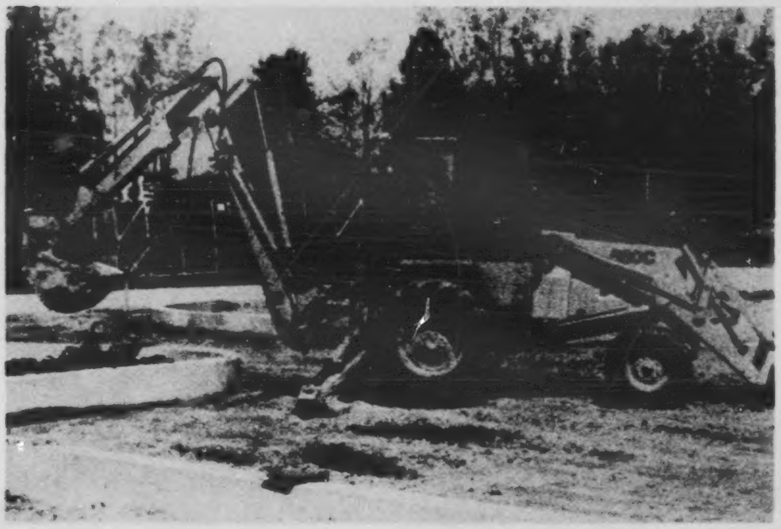
JOB SHEET #7--SET UP MACHINE ON LEVEL TERRAIN AND ON SLOPED TERRAIN

I. Equipment--Backhoe

II. Procedure

A. Level terrain (Figure 17)

FIGURE 17



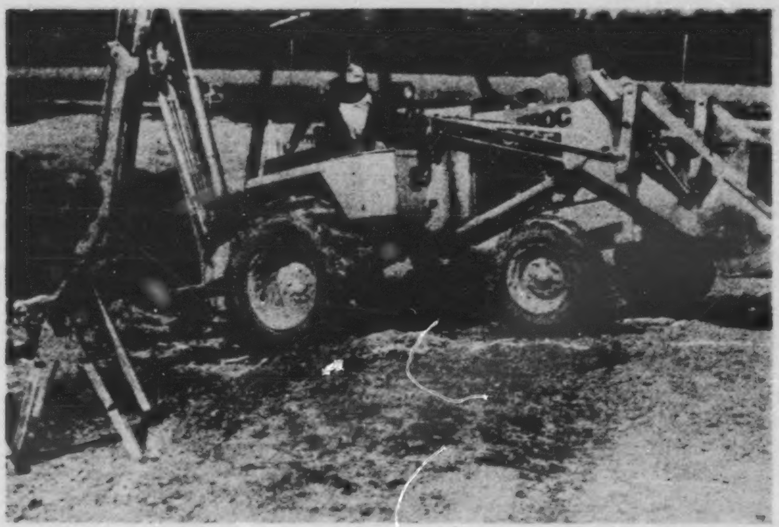
1. Position backhoe as near level as possible
2. Lower the loader bucket to the ground enough to take most of the pressure off the front wheels
3. Lower stabilizers (outriggers) to the ground enough to take most of the pressure off the rear wheels
4. Adjust loader and stabilizer controls enough to level the backhoe
5. Begin digging operations

JOB SHEET #7

B. Sloped terrain (Figure 18)

(NOTE: For safety, the backhoe should not be operated on slopes or sides of hills at an angle of more than 15 degrees.)

FIGURE 18



1. Lower the loader bucket to the ground just enough to take pressure off front wheels
2. Lower stabilizer on downhill side enough to level backhoe
3. Lower opposite stabilizer to ground
4. Adjust both stabilizers at the same time to raise backhoe enough to take most of the weight off rear wheels
5. Adjust loader bucket to level backhoe
6. Begin digging operations

(NOTE: If the sidehill trench is to be backfilled, pile the soil on the uphill side if possible.)

BACKHOES
UNIT II

JOB SHEET #8--OPERATE A BACKHOE TO DIG A 32' X 50' X 5' BASEMENT

I. Equipment--Backhoe

II. Procedure

  A. Mount backhoe and start engine

  B. Raise outriggers (stabilizers)

  C. Raise loader bucket

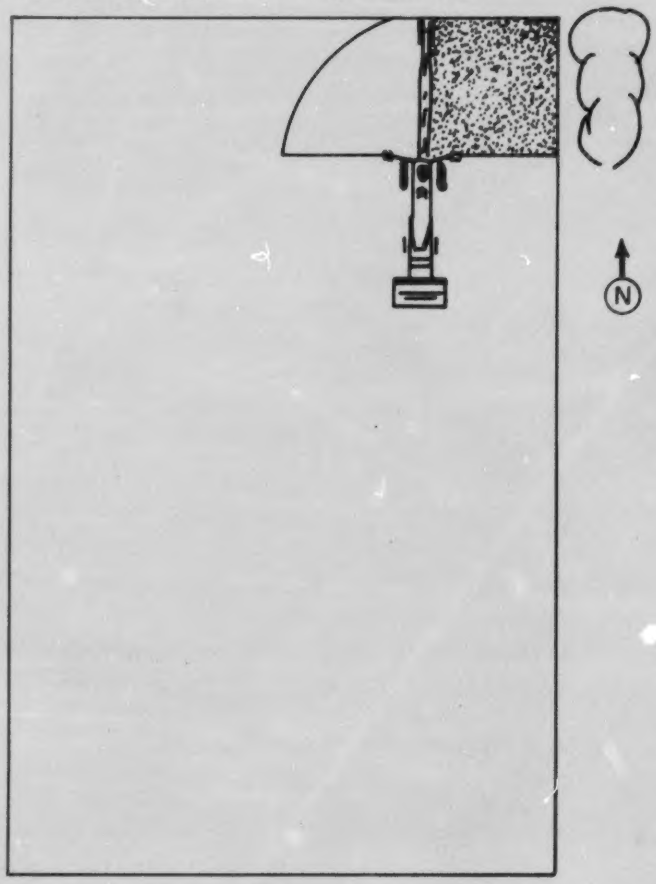
  D. Place boom in transport position

  E. Travel to basement location

  (NOTE: A rough sketch of how and where to start digging has been made so that digging procedures can start immediately.)

  F. Set up backhoe in starting position (Figure 19)

FIGURE 19



JOB SHEET #8

G. Lower loader bucket to the ground enough to take pressure off front tires

H. Move to backhoe controls

I. Lower outriggers to the ground until most of rear weight of backhoe is on the outriggers and backhoe is in a level position

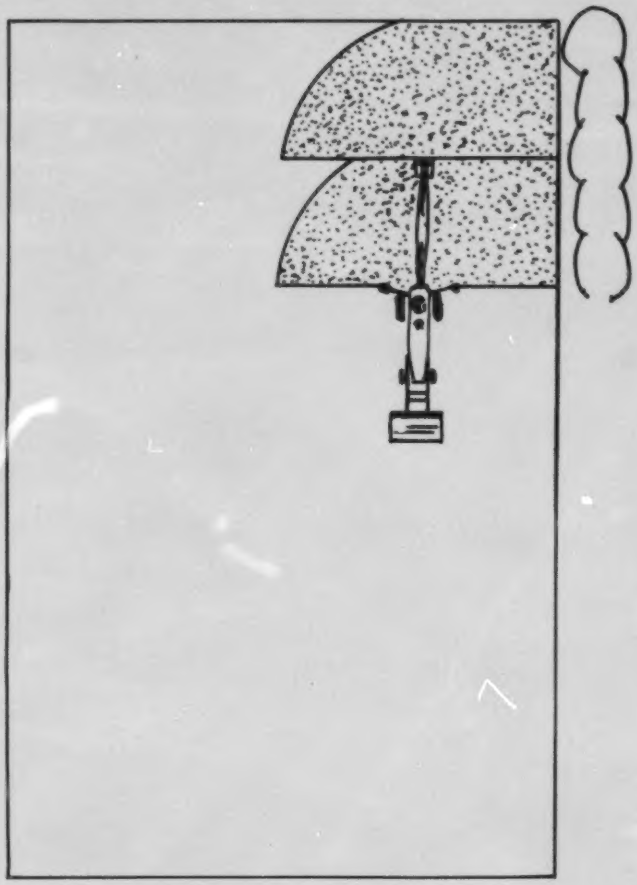
J. Start digging; continue digging until this area is completely dug

K. Move and set up in the next position when this area (all that can be reached from this position) is complete

L. Set up in the second position

(NOTE: Second position will be back far enough that the bucket will just barely reach the previous cut; see Figure 20.)

FIGURE 20



JOB SHEET #8

M. Start digging

N. Continue digging until this area is complete

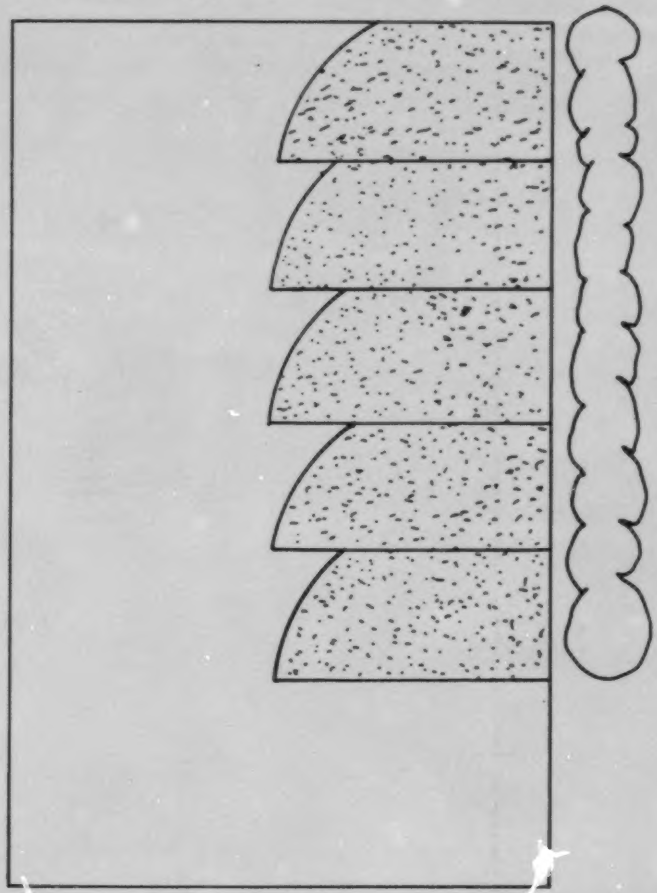
O. Move and set up in the next position when this area has been completely dug

P. Set up in the third position and dig this area

Q. Move to next position and set up when this area is done

R. Continue moving, setting up, and digging until opposite end of basement is reached (Figure 21)

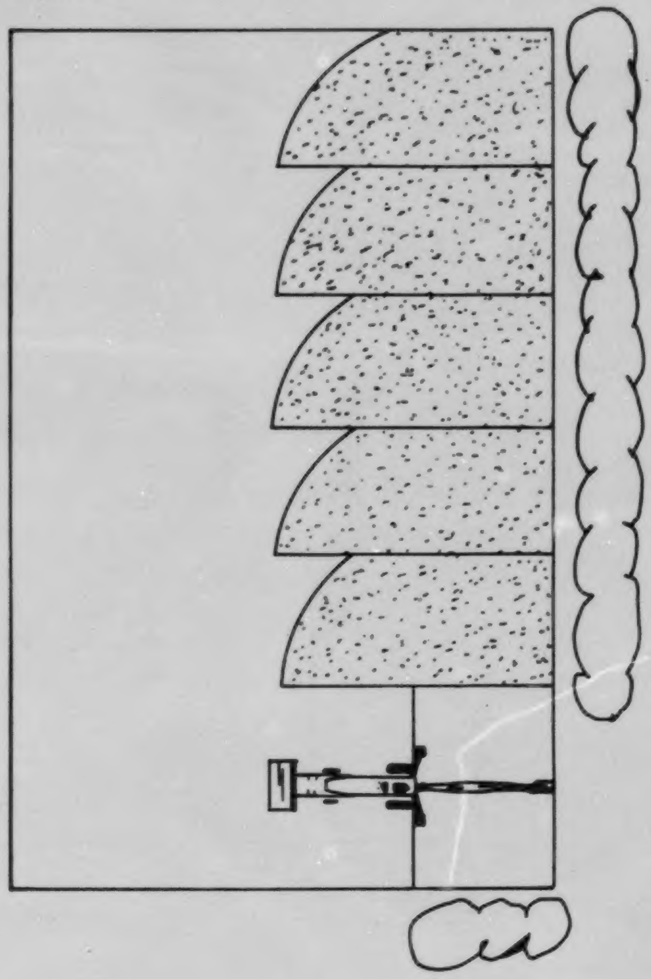
FIGURE 21



JOB SHEET #8

S. Turn backhoe at a right angle to cut and position it to dig out corner of basement (Figure 22)

FIGURE 22



T. Set up in this position and dig out this area

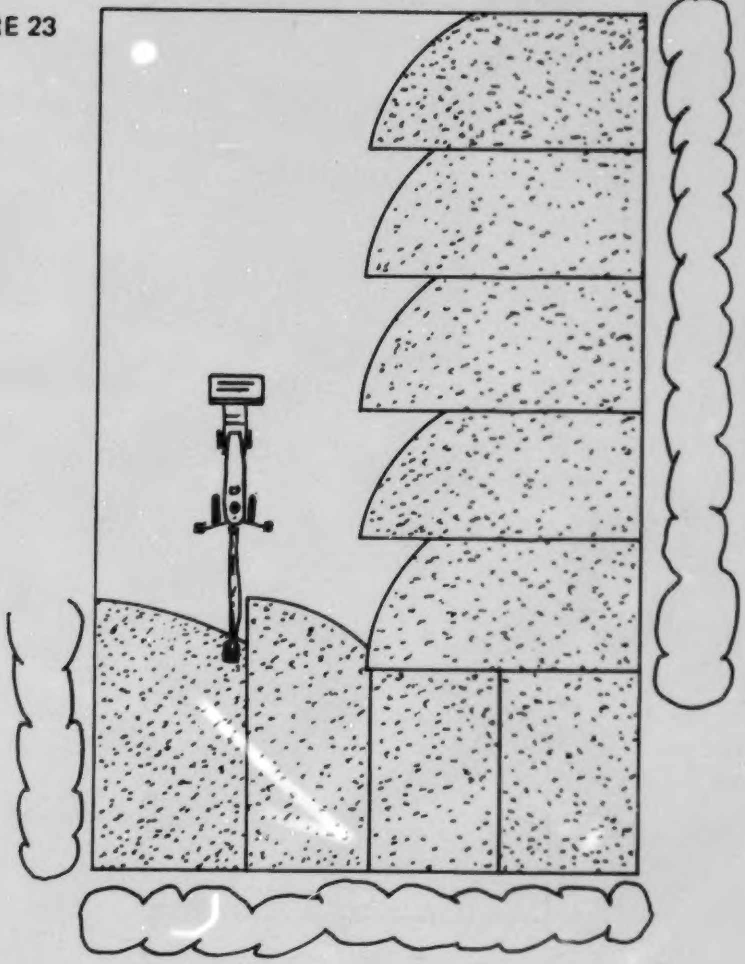
U. Move to next position and set up

V. Continue moving across end of basement until reaching opposite side

JOB SHEET #8

W. Turn at right angles and start down this side of basement (Figure 23)

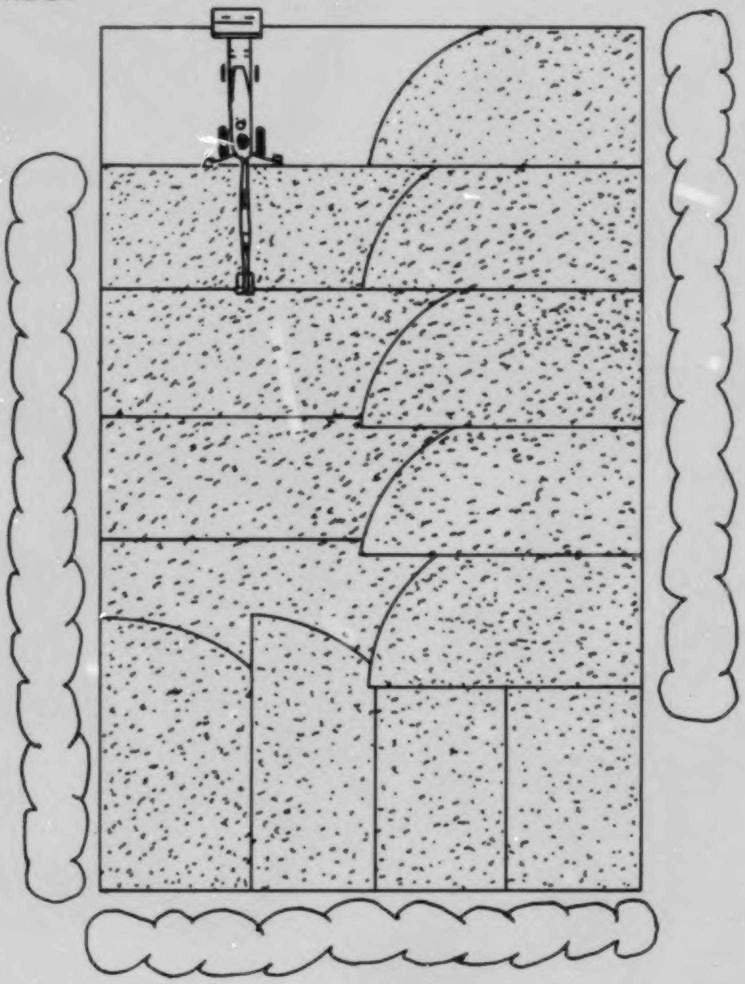
FIGURE 23



JOB SHEET #8

X. Continue setting up and digging down this side of basement until opposite end of basement is reached (Figure 24)

FIGURE 24



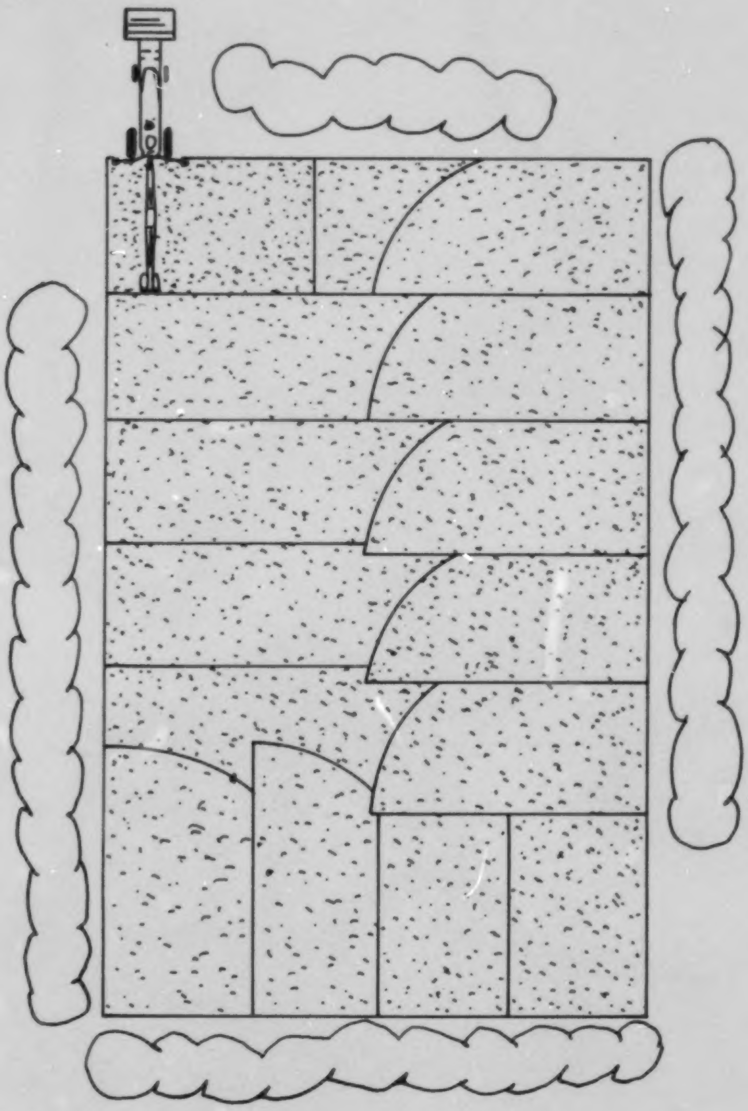
JOB SHEET #8

Y. Turn to the left and clean up across the end

Z. Turn back to the south and continue digging until basement is complete (Figure 25)

(NOTE: This method will leave a straight, vertical wall, an even floor, and no ramps or uncleared areas.)

FIGURE 25



BACKHOES
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. List uses of backhoes.

   a. ____

   b. ____

   c. ____

   d. ____

2. Match terms associated with backhoes to their correct definitions. Write the correct numbers in the blanks.

   ______a. Temporary bracing to hold sides of excavation and keep them from caving in

   ______b. Kit used to secure or make safe

   ______c. Slow-moving vehicle

   ______d. Rotate the bucket

   ______e. Process of forcing a bucket into digging; mechanism which does the forcing

   1. Lock-up kit
   2. Crowd
   3. Shoring
   4. Curl
   5. SMV

3. State six safety rules related to backhoes.

   a. ____

   ____

   b. ____

   ____

   c. ____

   ____

   d. ____

   ____

   e. ____

   ____

TEST

f. ____

____

4. List types of backhoes.

a. ____

b. ____

c. ____

d. ____

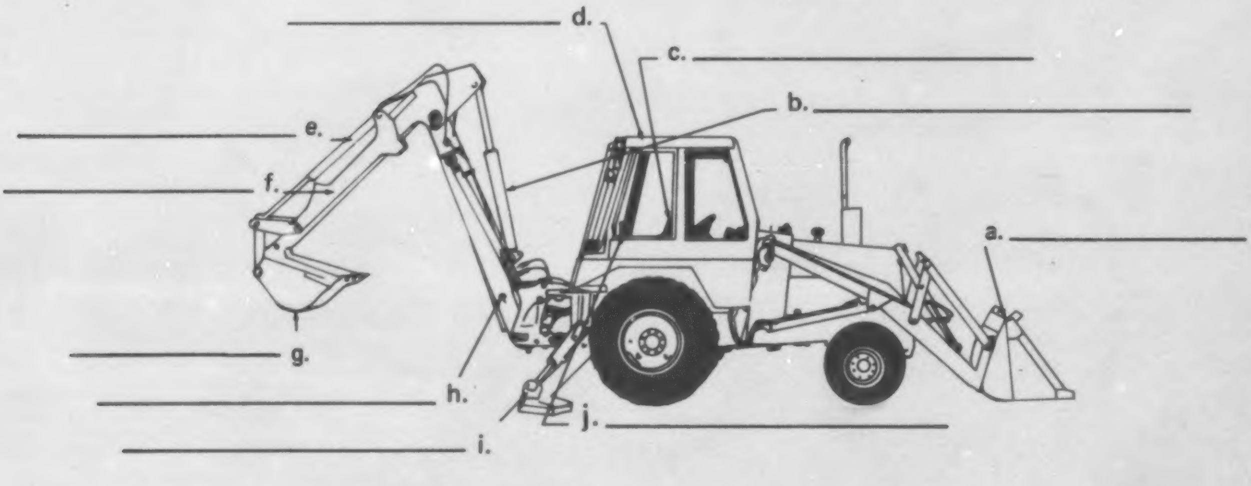
e. ____

f. ____

g. ____

5. Identify basic components of a backhoe. Write the correct names in the blanks.

Loader bucket
Bucket (dipper)
Dipper arm
Backhoe controls
Reversible seat
Outrigger
Dipper cylinder
Rollover protective structure (ROPS)
Boom hoist cylinder
Boom



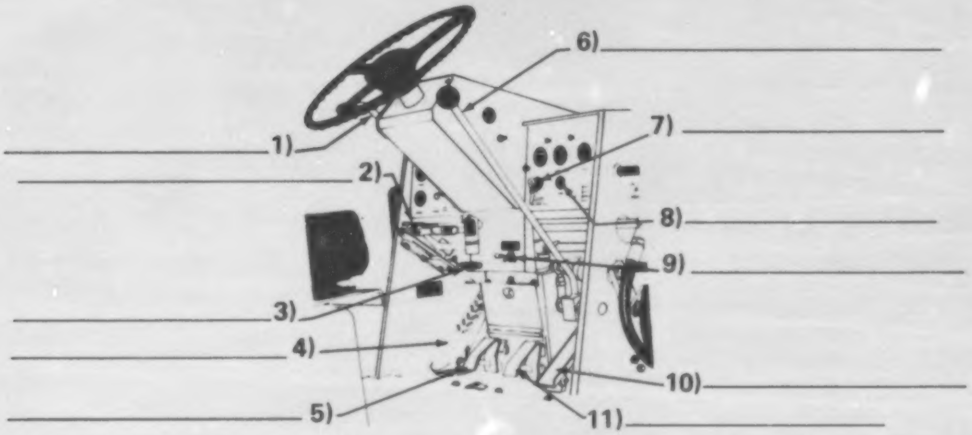
TEST

6. Identify controls on a typical backhoe. Write the correct terms in the blanks.

a. **TRACTOR**

Individual left rear wheel
Individual right rear wheel
Brake pedal
Foot throttle
Fuel shutoff
Front bucket control

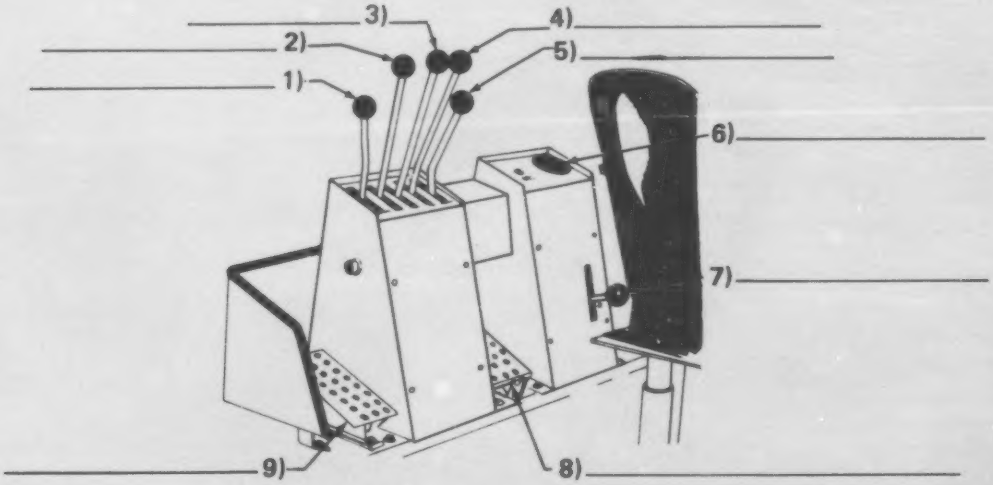
Range/direction lever
Clutch cutout
Starter button
Key switch
Parking brake



b. **BACKHOE**

Left swing foot control
Bucket control
Dipper control
Right swing foot control
Hand throttle

Left-hand stabilizer
Hourmeter
Right-hand stabilizer
Boom control



TEST

7. Select from the following list types of safety and security devices that should be standard equipment on backhoes. Write an "X" in the blank before each correct answer.

_____a. Spark-arresting muffler

_____b. Rollover protective structure

_____c. AGC emblem

_____d. Cab overhead light

_____e. Horn

_____f. Wheel weights

_____g. Backup lights

_____h. Lock-up kit

_____i. Brake air reservoir warning buzzer

_____j. Boom safety lock

_____k. Stop/taillights and flasher lights

_____l. Tire chains

_____m. Forward/reverse safety lock

_____n. Backup alarm

_____o. SMV emblem

8. State eight suggestions for effective backhoe operations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

TEST

9. Select from the following list items to check on a daily inspection. Write an "X" in the blank before each correct answer.

______a. Controls, for proper functioning

______b. Defroster

______c. Air cleaner

______d. Boom swing

______e. Drive belt pulleys

______f. Engine oil level

______g. Fuel level

______h. Windshield wiper motor

______i. Transmission fluid level

______j. Rear axle oil level

______k. Hydraulic fluid level

______l. Battery electrolyte level and battery cable connections

______m. Shovel components

______n. Brakes

10. Select from the following list items to check when servicing a backhoe. Write an "X" in the blank before each correct answer.

______a. Greasy fittings

______b. Engine coolant level, radiator cap, hose, and radiator

______c. Water hose clamps

______d. Fuel level, fuel filters, and sediment bowl (where applicable)

______e. Air cleaner outlet screen

______f. Transmission pressure line filter and breather

______g. Tire tubes and valves

______h. All safety devices

TEST

______i. Rear axle oil level

______j. All gauges and temperature controls for adequate lubrication

______k. Battery electrolyte level, battery cables, and connectors

______l. Hydraulic valve operation

______m. Drive belts for tension and wear

______n. Hydraulic fluid level, filters, hose, lines, fittings, and possible leaks

(NOTE: Test questions 11 and 12 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. List equipment and materials needed to service a backhoe.

12. Demonstrate the ability to

    a. Start, warm up, check gauges, and check controls for performance; shut down machine.

    b. Perform daily inspection on a backhoe.

    c. Service a backhoe.

    d. Carry a straight line while excavating a ditch and loading a haul truck.

    e. Operate a backhoe, using a hydraulic breaker.

    f. Operate backhoe to set pipe.

    g. Set up machine on level terrain and on sloped terrain.

    h. Operate a backhoe to dig a 32' x 50' x 5' basement.

BACKHOES
UNIT II

ANSWERS TO TEST

1. a. Digging and cleaning narrow ditches
   b. Excavating small areas where it is not practical for other equipment
   c. Light-duty hoisting
   d. Loading trucks

2. a. 3
   b. 1
   c. 5
   d. 4
   e. 2

3. Answer should include any six of the following
   a. Do not permit anyone to stand alongside trench being excavated
   b. Check all component hinge pins and their securing devices often
   c. Be sure outriggers are properly extended before starting operations.
   d. Observe extreme caution when operating under low overhead obstructions
   e. Observe extreme caution when excavating where there may be underground wires and pipes
   f. Always use warning signs and proper control procedures when working on roads or streets
   g. Never perform service or repairs on equipment that has not been properly blocked and secured
   h. Keep bucket as close to ground as possible when transporting loads, and travel at safe operating speed

4. a. Crawler-type, cable-operated
   b. Rubber-tired tractor-type, hydraulically operated
   c. Truck-mounted, cable-operated
   d. Truck-mounted, hydraulic
   e. Crawler-type, hydraulically operated

ANSWERS TO TEST

f. Multi-purpose hydraulic

g. Trenching machine with backhoe accessory

5. a. Loader bucket
   b. Boom hoist cylinder
   c. Reversible seat
   d. Rollover protective structure (ROPS)
   e. Dipper cylinder
   f. Dipper arm
   g. Bucket (dipper)
   h. Boom
   i. Outrigger
   j. Backhoe controls

6. a. **TRACTOR**
   1) Range/direction lever
   2) Parking brake
   3) Fuel shutoff
   4) Brake pedal
   5) Individual left rear wheel
   6) Front bucket control
   7) Key switch
   8) Starter button
   9) Clutch cutout
   10) Foot throttle
   11) Individual right rear wheel

   b. **BACKHOE**
   1) Left-hand stabilizer
   2) Bucket control
   3) Dipper control
   4) Boom control
   5) Right-hand stabilizer
   6) Hourmeter
   7) Hand throttle
   8) Right swing foot control
   9) Left swing foot control

7. a, b, e, g, h, i, k, m, n, o

8. Answer should include any eight of the following
   a. Set up work cycle so that it will be as short as possible
   b. Keep transport distances as short as possible
   c. Carry bucket just high enough to clear obstacles when transporting load
   d. Start raising boom so that bucket will reach dumping height at the time it arrives at the dump area

ANSWERS TO TEST

e. Fill truck gradually from far side to near side

f. Work from top down and take shallow bites to fill bucket

g. When dumping bucket, actuate crowd and bucket cylinders at same time to be ready for return cycle

h. Pick up bucket when it is full

i. Curl bucket close to dipper arm to prevent spilling when loading trucks

j. Keep machine clean

k. Service machine regularly

l. Keep radiator free of bugs and trash during hot weather

9. a, c, f, g, i, k, l

10. b, d, f, h, i, k, m, n

11. Evaluated to the satisfaction of the instructor

12. Performance skills evaluated to the satisfaction of the instructor

TRENCHING AND DITCHING MACHINES
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of trenching and ditching machines and should be able to operate a machine to perform trenching and/or ditching operations. This knowledge will be shown by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Describe uses of trenching and ditching machines.
2. Match terms associated with trenching and ditching machines to their correct definitions.
3. Identify types of trenching and ditching machines.
4. Label basic components of a chain ditcher.
5. Label controls on a chain ditcher.
6. Label basic components of a wheel ditcher.
7. Label basic components of a ladder ditcher.
8. Identify accessories used on trenchers and ditchers.
9. Describe the purpose of a conveyor belt.
10. Describe the purpose of a shoe post and/or crumber.
11. State safety precautions related to trenchers and/or ditchers.
12. State suggestions for effective trenching and ditching operations.
13. Select from a list items to check when servicing a trencher or ditcher.
14. List materials needed to service a trencher or ditcher.
15. Demonstrate the ability to
    - a. Perform daily inspection on a ditcher.
    - b. Start, warm up, check gauges, and check controls for performance; make final visual inspection and shut down machine.

TRENCHING AND DITCHING MACHINES
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Order materials planned to supplement unit--Film--*Barber-Greene Pipeline Ditchers*, TA--65 and TA--77. Color, 16 mm, 14 minutes, Barber-Greene, n.d. Available from Barber-Greene, 400 N. Highland Avenue, Aurora, Illinois 60507.
- B. Provide students with objective sheet.
- C. Provide students with information, assignment, and job sheets.
- D. Discuss unit and specific objectives.
- E. Discuss information and assignment sheets.
- F. Demonstrate and discuss procedures outlined in job sheets.
- G. Obtain operator's service guides for type of equipment being used.
- H. Take students on tour of ditching or trenching machine manufacturing plant.
- I. Give test.

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Assignment Sheet #1--List Materials Needed to Service a Trencher or Ditcher
- E. Answers to assignment sheet
- F. Job sheets
  1. Job Sheet #1--Perform Daily Inspection on a Ditcher
  2. Job Sheet #2--Start, Warm up, Check Gauges, and Check Controls for Performance; Make Final Visual Inspection and Shut Down Machine
- G. Test
- H. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. *Cleveland Trencher.* St. Paul, Minnesota: Division of American Hoist, n.d.

B. *Ditch Witch Operator's Manual and Parts List, Model 4010.* Perry, Oklahoma: Charles Machine Works, Inc., 1981.

C. Industrial Construction Equipment Division. *Safety Manual.* Chicago, Illinois: Farm and Industrial Equipment Institute, 1977.

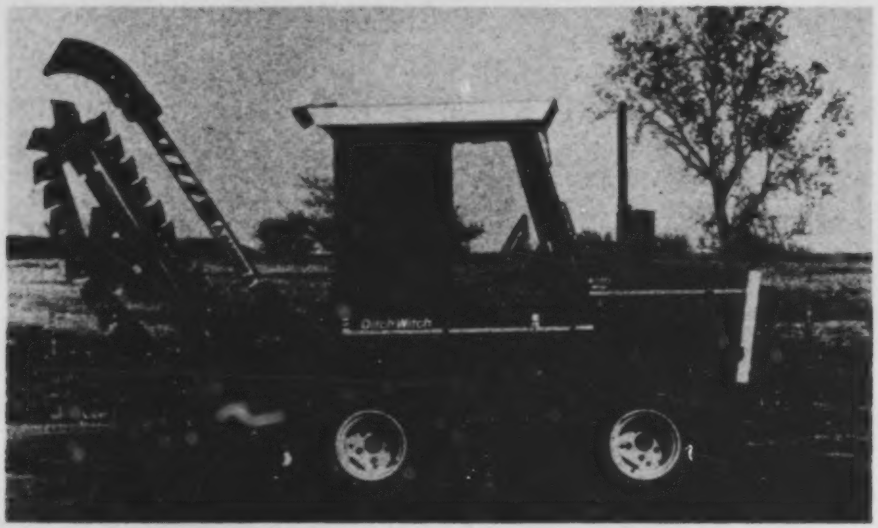
D. Nichols, Herbert L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

TRENCHING AND DITCHING MACHINES
UNIT III

INFORMATION SHEET

I. Uses of trenching and ditching machines--Used to dig ditches or trenches, to remove soil, and, in some circumstances, to backfill ditches or trenches (Figure 1)

FIGURE 1



Courtesy of the Charles Machine Works, Inc.

II. Terms and definitions

A. Trench--An excavation made for the purpose of installing or removing items, such as pipes, drains, or catch basins, and later refilled

B. Ditch--Long, narrow excavation for drainage, irrigation, or burying underground pipelines

C. Windrow--Ridge of loose dirt

D. Conveyor--Device that transports material by belts, cables, or chains

E. Shoe post (crumber)--Cleanup device that follows buckets of a ditching machine

F. Sighting stakes--Continuous line of stakes set along the path of the planned ditch or trench

G. Electronic sensor--Automatic control system that maintains accurate line and grade

H. ROPS--Rollover protective structure

INFORMATION SHEET

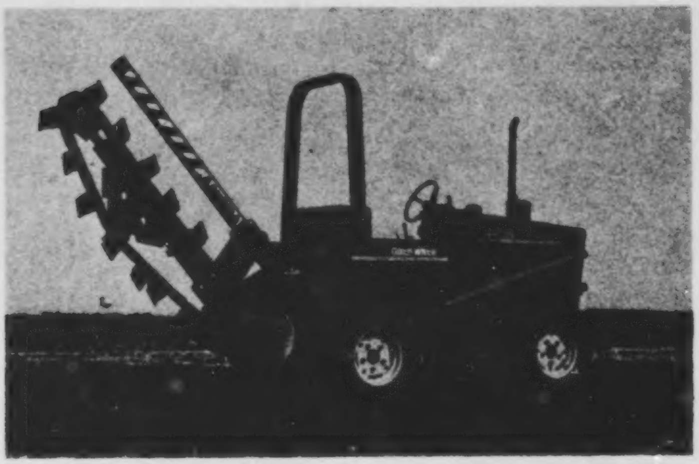
I. Trapezoidal ditch--Type of ditch that usually has a flat bottom with sloped, parallel sides

(NOTE: A wheel ditcher may be fitted with side cutters [cones] that allow the wheel to produce this shape in one pass.)

III. Types of trenching and ditching machines (Figures 2-7)

A. Chain

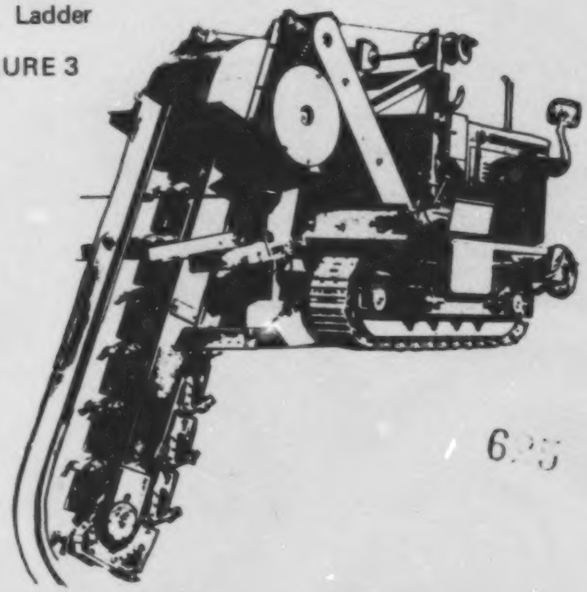
FIGURE 2



Courtesy of the Charles Machine Works, Inc.

B. Ladder

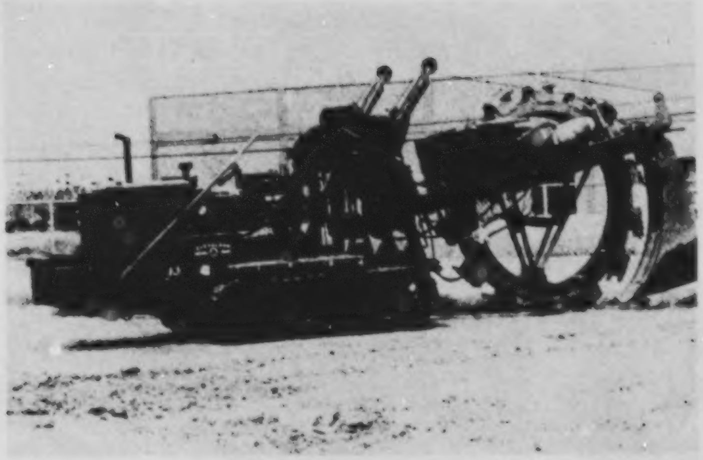
FIGURE 3



INFORMATION SHEET

C. Wheel

FIGURE 4



D. Backhoe

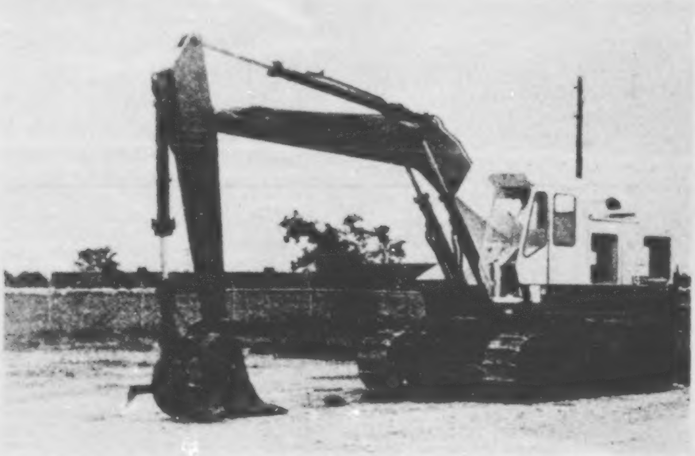
FIGURE 5

Courtesy of Caterpillar Tractor Company.

INFORMATION SHEET

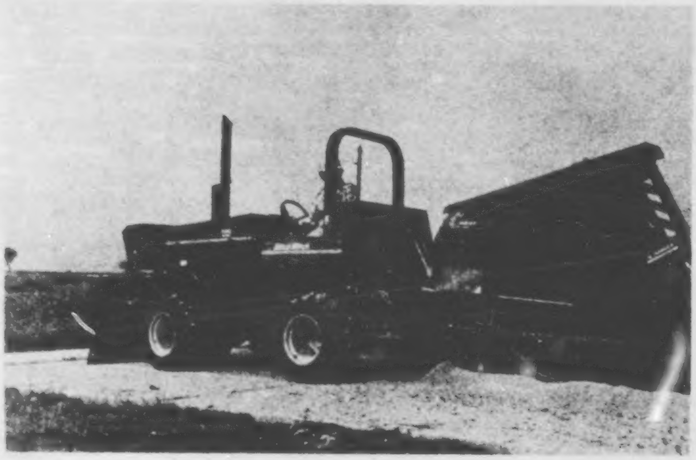
E. Excavator hoe

FIGURE 6



F. Earth saw (concrete and rock cutter)

FIGURE 7

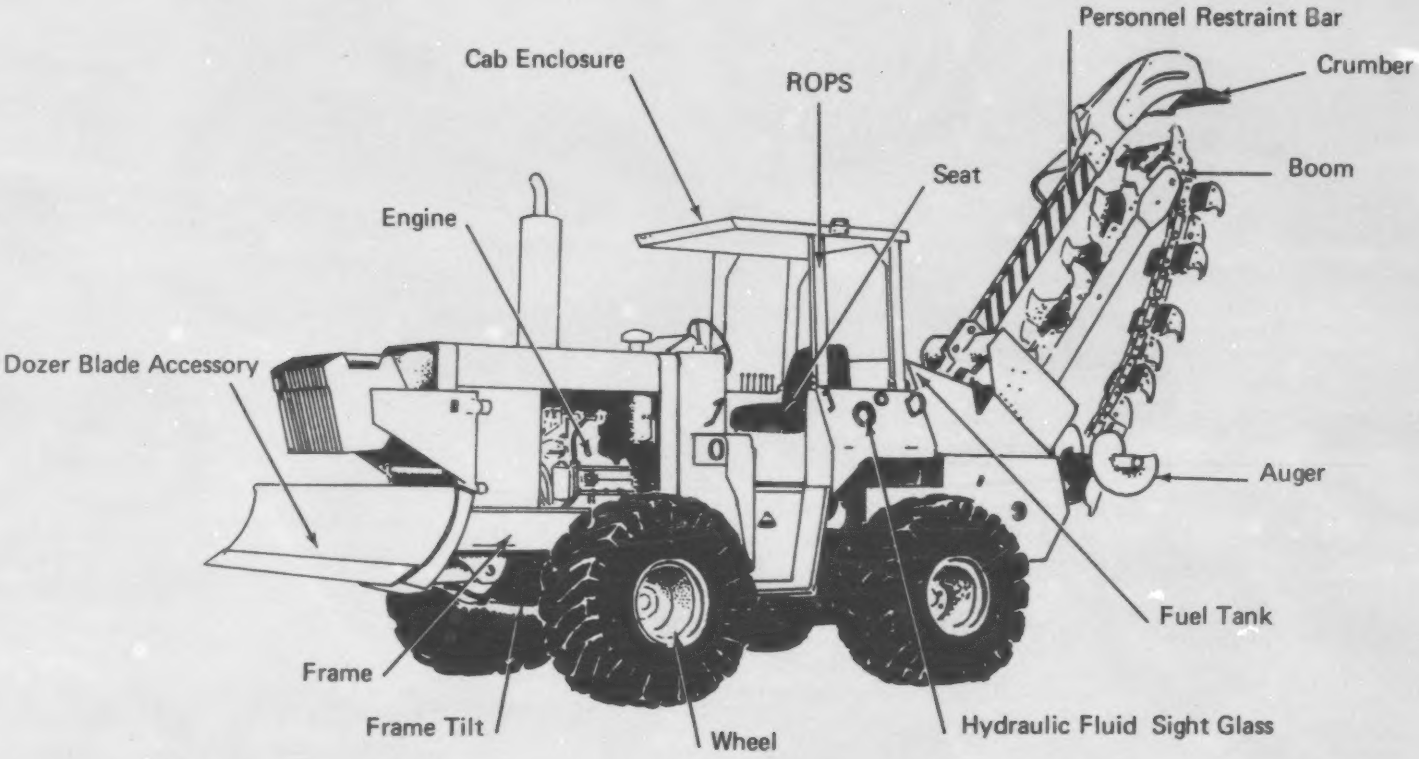


Courtesy of the Charles Machine Works, Inc.

INFORMATION SHEET

IV. Basic components of a chain ditcher (Figure 8)

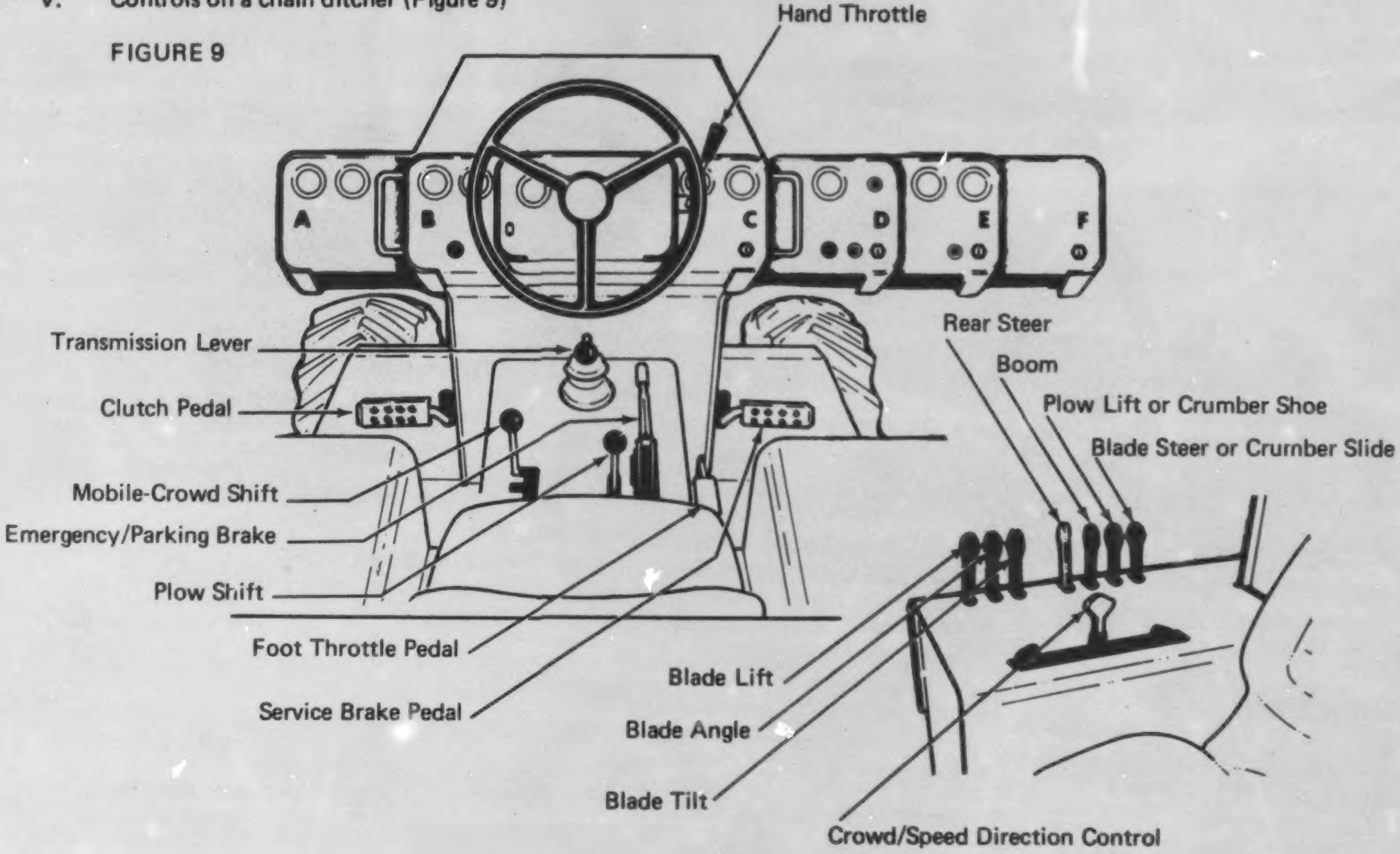
FIGURE 8


Personnel Restraint Bar
Crumber
Cab Enclosure
ROPS
Seat
Boom
Engine
Dozer Blade Accessory
Auger
Fuel Tank
Frame
Frame Tilt
Wheel
Hydraulic Fluid Sight Glass

INFORMATION SHEET

V. Controls on a chain ditcher (Figure 9)

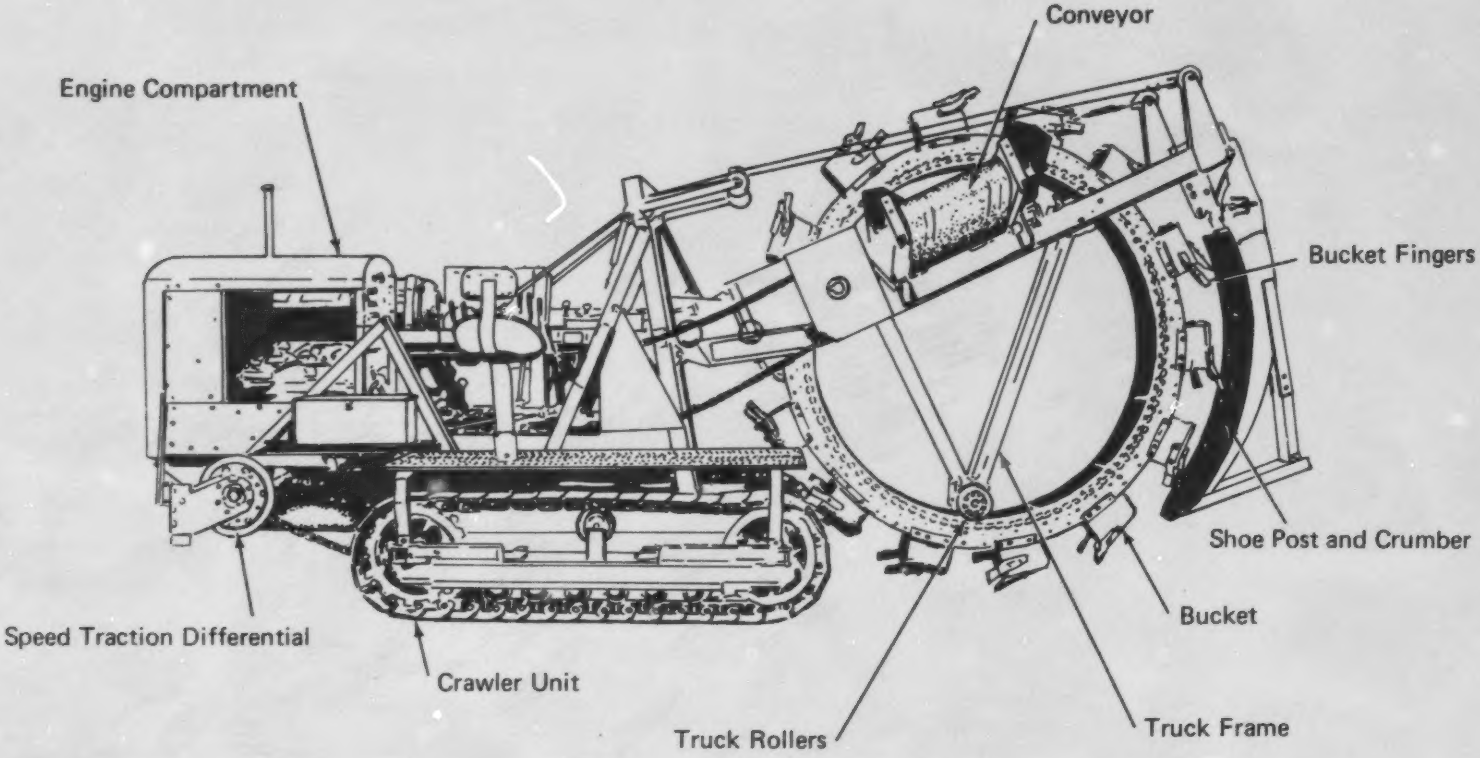
FIGURE 9


Hand Throttle
A
B
C
D
E
F
Transmission Lever
Clutch Pedal
Mobile-Crowd Shift
Emergency/Parking Brake
Plow Shift
Foot Throttle Pedal
Service Brake Pedal
Rear Steer
Boom
Plow Lift or Crumber Shoe
Blade Steer or Crumber Slide
Blade Lift
Blade Angle
Blade Tilt
Crowd/Speed Direction Control

INFORMATION SHEET

VI. Basic components of a wheel ditcher (Figure 10)

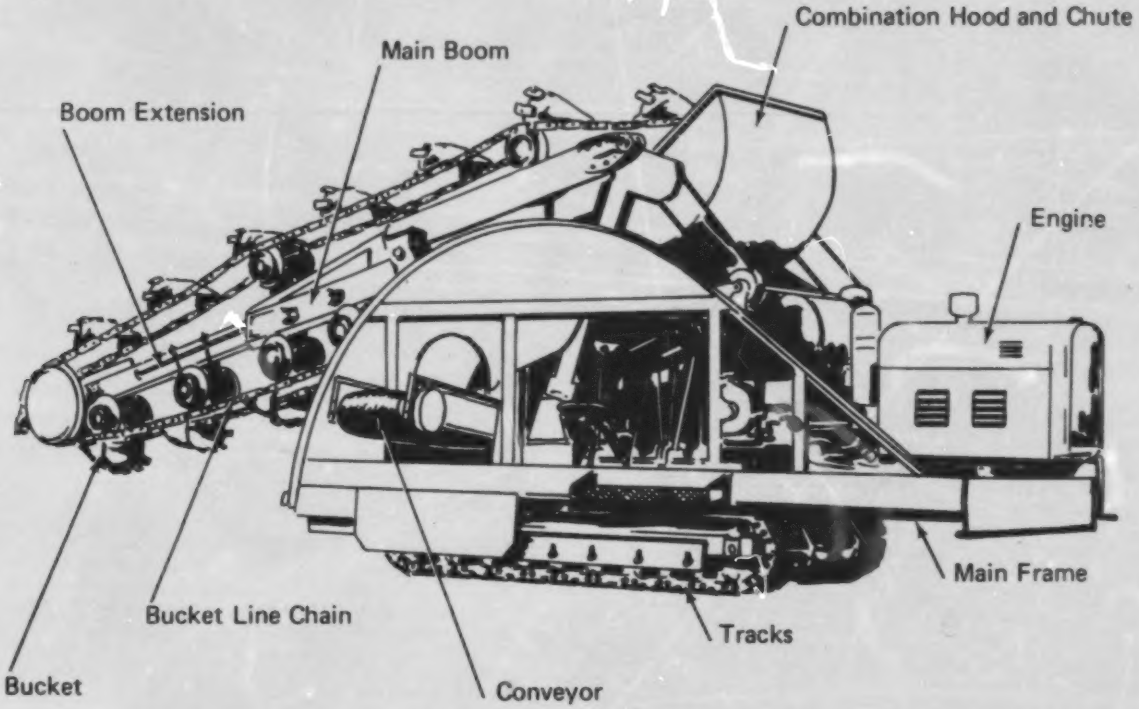
FIGURE 10


Conveyor
Engine Compartment
Bucket Fingers
Shoe Post and Crumber
Bucket
Speed Traction Differential
Crawler Unit
Truck Rollers
Truck Frame

INFORMATION SHEET

VII. Basic components of a ladder ditcher (Figure 11)

FIGURE 11

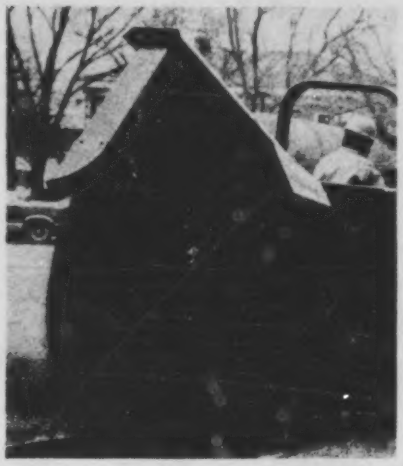

Combination Hood and Chute
Main Boom
Boom Extension
Engine
Main Frame
Bucket Line Chain
Tracks
Bucket
Conveyor

INFORMATION SHEET

VIII. Accessories used on trenchers and ditchers (Figures 12-20)

A. Earth saw (concrete and rock cutter)

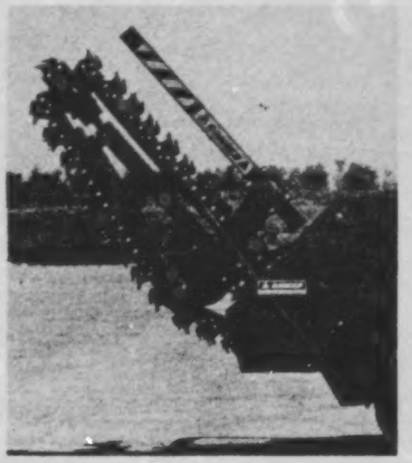
FIGURE 12



Courtesy of the Charles Machine Works, Inc.

B. Alligator digging chain

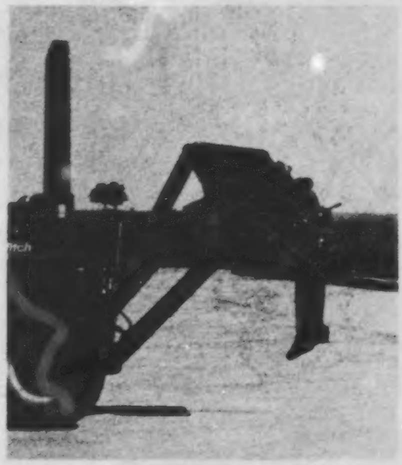
FIGURE 13



Courtesy of the Charles Machine Works, Inc.

C. Vibratory plow

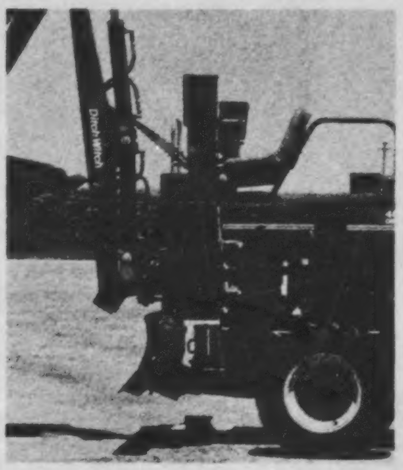
FIGURE 14



Courtesy of the Charles Machine Works, Inc.

D. Outriggers

FIGURE 15



Courtesy of the Charles Machine Works, Inc.

INFORMATION SHEET

E. Dozer blade

FIGURE 16

Courtesy of the Charles Machine Works, Inc.

F. Cable reel carrier

FIGURE 17

Courtesy of the Charles Machine Works, Inc.

G. Backhoe

FIGURE 18

Courtesy of the Charles Machine Works, Inc.

INFORMATION SHEET

H. Drill

FIGURE 19

Courtesy of the Charles Machine Works, Inc.

I. Boring attachment

FIGURE 20

Courtesy of the Charles Machine Works, Inc.

IX. Purpose of a conveyor belt--To carry dirt to either side of the machine and leave a windrow

X. Purpose of a shoe post and/or crumber--To support back of ditcher wheel; pushes spillage ahead until it is picked up again and rounds and smooths the bottom of ditch.

XI. Safety precautions related to trenchers and/or ditchers

A. Do not alter or remove safety equipment

B. Use safety belt

C. Keep others away from operations

D. Use extreme caution on slopes and inclines

E. Wear all required protective clothing and safety gear

F. Do not touch machine to check for hydraulic leaks

G. Do not open radiator cap unless engine is cool, then open slowly to release pressure

INFORMATION SHEET

H. Use grab irons and steps when mounting and dismounting equipment

I. Check work area for holes, drop-offs, or obstacles before starting machine

J. Do not approach overhead or underground power cables with any part of trencher until all local, state, and federal (OSHA) safety requirements have been met

K. Make sure no one is under, on, or near equipment before starting

L. Do not overfill fuel tank

M. Do not fill fuel tank with engine running

N. Do not fill fuel tank when smoking or when near an open flame

O. Do not mount or jump from moving equipment

P. Check, before starting, to be sure you can stop and can control speed and direction

Q. Do not permit riders on equipment

R. Adjust travel speed to ground conditions when moving

S. Stay alert to changes in soil conditions

(NOTE: Train yourself to be able to identify types of materials by sound and feel.)

T. Do not drop a moving chain or wheel to the ground

U. Do not leave a machine unattended while engine is running

V. Do not work on, or clean any part of machine with engine running

(NOTE: Knowledge of these safety precautions will help build good judgment in all situations and help develop good safety habits to become a better operator.)

XII. Suggestions for effective trenching and ditching operations

A. Replace digging teeth whenever they are worn

B. Operate engine at full throttle under load

C. Do not allow engine to labor

D. Keep front wheels parallel to basic unit frame for a straight trench

E. Always use correct length of digging boom

INFORMATION SHEET

F. Never turn too sharply

G. Keep equipment clean

H. Have equipment serviced regularly

I. Keep attachment low when traveling on a slope

J. Travel slowly and cautiously when moving machine

K. Make turns with boom fully down when possible

XIII. Items to check when servicing a trencher or ditcher (Assignment Sheet #1)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Visual inspection for broken, worn, or missing parts, and leaks

B. Engine oil level, filter, lines, and hoses

C. Air cleaner filter (element)

D. Engine coolant level, radiator cap, hose, and radiator

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Fuel level, fuel filters, and sediment bowl (where applicable)

F. Battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Exhaust system

H. Hydraulic fluid level, filters, hose, lines, fittings, and leaks

I. Transmission fluid level

J. Transmission pressure line filter and breather

K. Brake adjustment and condition

L. Brake master cylinder fluid level

M. Clutch for proper adjustment

N. Drive belts for tension and wear

INFORMATION SHEET

O. Wiring, insulation, and connections

P. Grease fittings

Q. Tires or tracks

R. All safety devices

S. Windshield wipers (where applicable)

T. Major components and/or accessories

U. Gauges and controls for proper functioning

V. Track drive chains and pads; adjust if necessary

W. Tracks; clean if necessary

X. Differential

TRENCHING AND DITCHING MACHINES
UNIT III

ASSIGNMENT SHEET #1--LIST MATERIALS NEEDED TO SERVICE A TRENCHER OR DITCHER

NAME________________________________ SCORE ________________

Using the Information Sheet and operator's manual, list materials needed to perform service on a trencher or ditcher.

A. ____

B. ____

C. ____

D. ____

E. ____

F. ____

G. ____

H. ____

I. ____

J. ____

K. ____

L. ____

M. ____

N. ____

TRENCHING AND DITCHING MACHINES
UNIT III

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

(NOTE: Types of lubricants may vary with different manufacturers' equipment. This lesson must be evaluated to the satisfaction of the instructor because of different types and manufacturers of equipment.)

A. Tool kit, new parts if necessary, and shop rags

B. Engine oil

C. Cleaning solution, brush, and air supply

D. Engine coolant and hydrometer

E. Diesel fuel or gasoline

F. Hydraulic fluid

G. Water or electrolyte, hydrometer, and capacity tester

H. Transmission fluid

I. Brake fluid and brake tools

J. Belt tension gauge or rule

K. Differential oil

L. Lubricating grease according to manufacturer's recommendation

M. Grease gun

N. Tire pressure gauge (if applicable)

TRENCHING AND DITCHING MACHINES
UNIT III

JOB SHEET #1--PERFORM DAILY INSPECTION ON A DITCHER

I. Equipment and materials

  A. Trenching or ditching machine

  B. Note pad and pencil

  C. Shop rags

  D. Gloves

II. Procedure

  A. Perform visual inspection, look for broken, worn, or missing parts and leaks

  (NOTE: Write down on pad any repairs that are needed.)

  B. Check engine oil level

  C. Check radiator coolant level

  D. Check battery electrolyte level and battery cable connections

  E. Check fuel level

  F. Check hydraulic fluid level

  G. Check air cleaner

  H. Check wires, connections, and insulation

  I. Check drive belts for condition and adjustment

  J. Check fuel pump sediment bowl (where applicable)

  K. Check transmission fluid level

  L. Check exhaust system

  M. Check safety devices

  N. Check tires or tracks

  O. Check cleanliness of equipment

  P. Check windshield wipers and windshield (where applicable)

JOB SHEET #1

Q. Check major components and/or accessories

R. Check gauges for normal operation

S. Check controls for proper functioning

T. Check brake pedals and/or levers

U. Check tracks, tumblers, and rollers for obstructions

TRENCHING AND DITCHING MACHINES
UNIT III

JOB SHEET #2--START, WARM UP, CHECK GAUGES, AND CHECK CONTROLS FOR PERFORMANCE; MAKE FINAL VISUAL INSPECTION AND SHUT DOWN MACHINE

I. Equipment and materials

(NOTE: If another piece of equipment is used, instead of a ladder ditcher, change procedures to suit the machine.)

A. Ladder ditcher (crawler type)

B. Note pad and pencil

C. Shop rags

D. Gloves

II. Procedure

A. Mount machine using steps and grab irons

B. Be sure all controls are in neutral position

C. Disengage clutch

D. Set throttle lever one-quarter (1/4) to one-half (1/2) open

E. Start engine

(NOTE: Do not crank engine for more than 20-30 seconds at a time.)

F. Bring engine to fast idle until normal temperature is reached

(CAUTION: If oil pressure gauge is not operating properly, shut off engine and determine problem.)

G. Alternate engine at high and low speeds a few times to make sure governor is functioning properly

H. Manipulate controls to move forward and backward

I. Manipulate controls to turn left and right

J. Manipulate controls to lower and raise boom

K. Manipulate controls to activate buckets and turn off

L. Manipulate controls to sideshift conveyor

JOB SHEET #2

M. Manipulate controls to turn belt on and off

N. Reset all controls to neutral position

O. Engage clutch

P. Be sure brakes are locked

Q. Dismount machine, using steps and grab irons

R. Make final visual inspection; check for leaks, listen for abnormal noises and be alert for any abnormal vibrations

S. Remount machine using steps and grab irons

T. Close throttle control

U. Let engine cool down

V. Turn engine off

W. Double-check to see that all controls are in neutral

X. Dismount machine using steps and grab irons

TRENCHING AND DITCHING MACHINES
UNIT III

TEST

NAME ________________________ SCORE ____________

1. Describe uses of trenching and ditching machines.

____

____

____

____

____

____

2. Match terms associated with trenching and ditching machines to their correct definitions. Write the correct numbers in the blanks.

_____a. An excavation made for the purpose of installing or removing items, such as pipes, drains, or catch basins, and later refilled

_____b. Long, narrow excavation for drainage, irrigation, or burying underground pipelines

_____c. Ridge of loose dirt

_____d. Device that transports material by belts, cables, or chains

_____e. Cleanup device that follows buckets of a ditching machine

_____f. Continuous line of stakes set along the path of the planned ditch or trench

_____g. Automatic control system that maintains accurate line and grade

_____h. Rollover protective structure

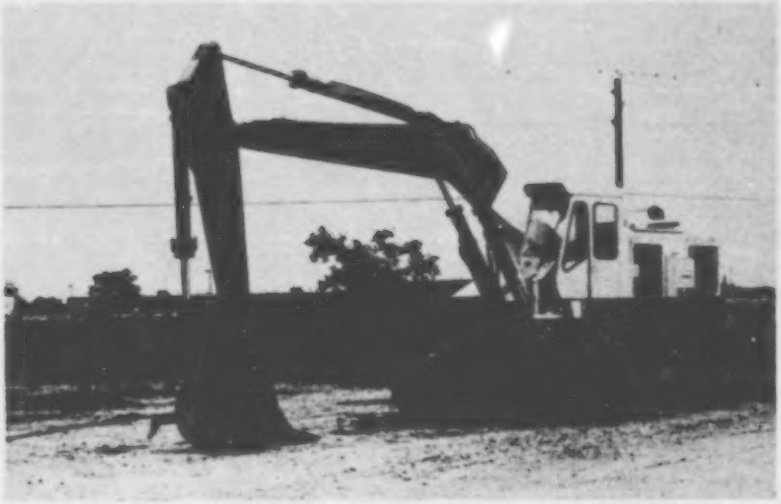
_____i. Type of ditch that usually has a flat bottom with sloped, parallel sides

1. Windrow
2. Shoe post (crumber)
3. Sighting stakes
4. Trench
5. Electronic sensor
6. Conveyor
7. Ditch
8. Trapezoidal ditch
9. ROPS

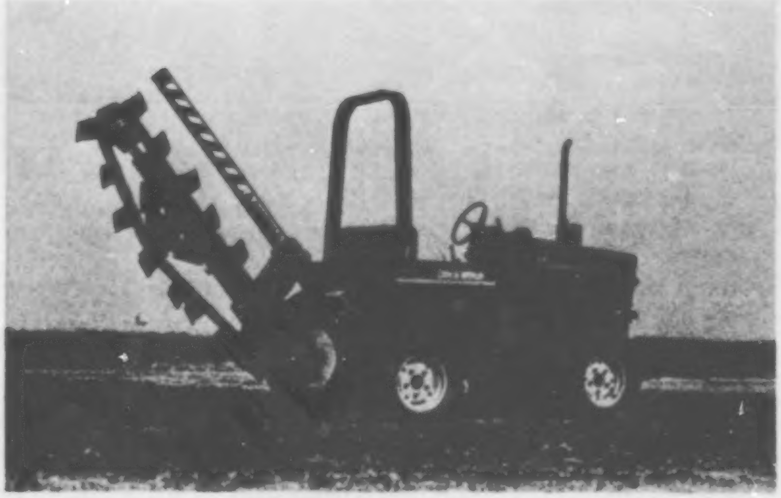
TEST

3. Identify the following types of trenching and ditching machines. Write the correct names in the blanks.

Ladder
Wheel
Chain
Backhoe
Excavator hoe
Earth saw (concrete and rock cutter)

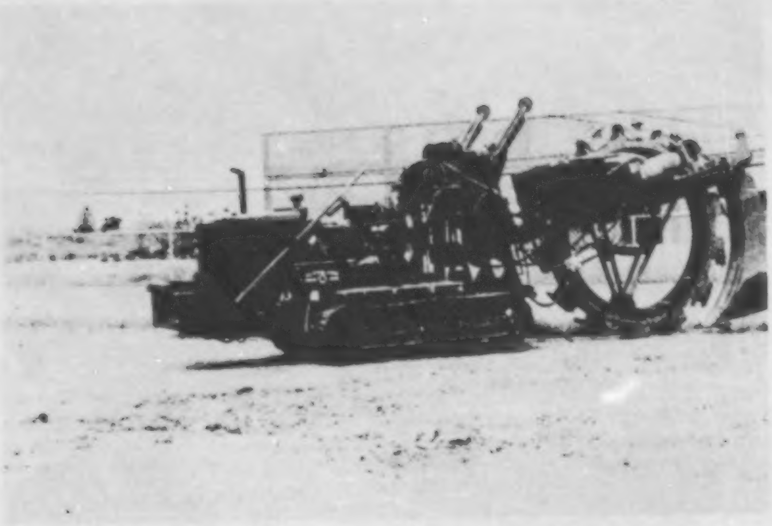


a. ____

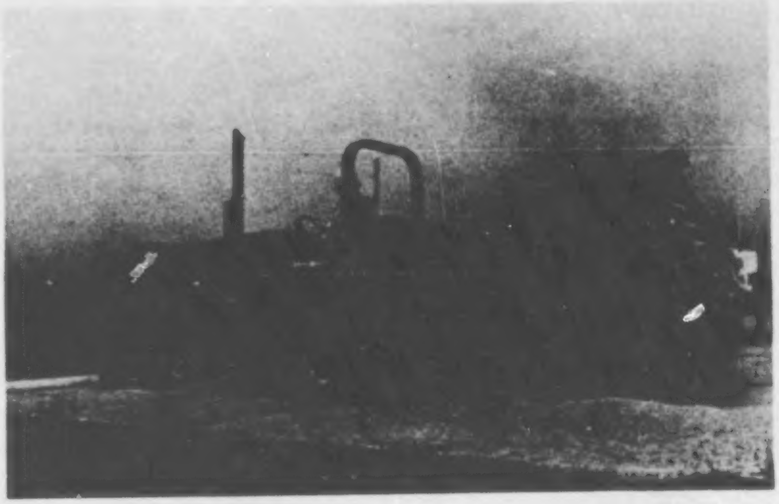


b. ____

TEST

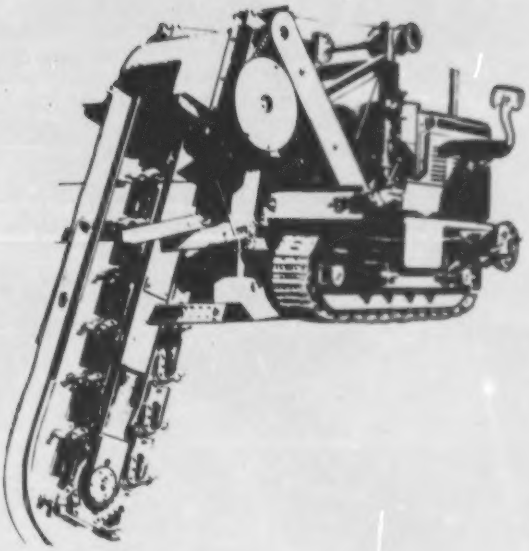


c. ______________________________

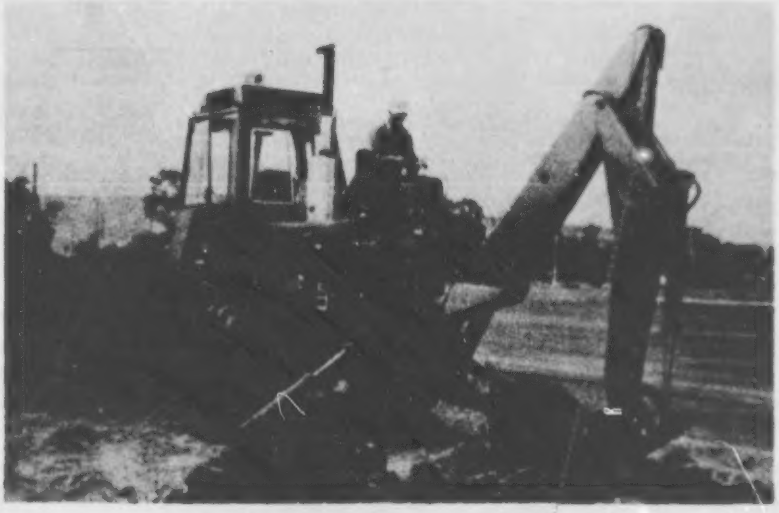


d. ______________________________

TEST



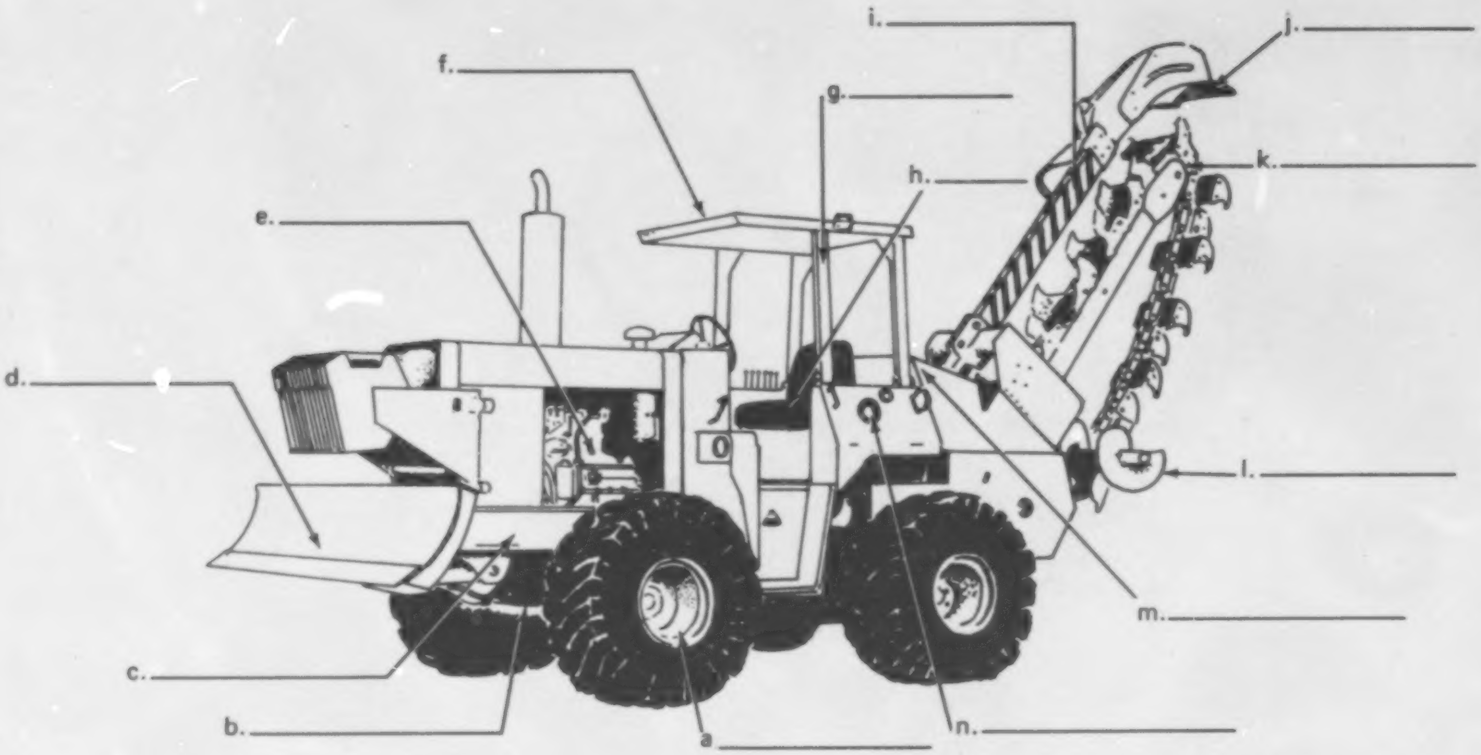
e. ______________________________



f. ______________________________

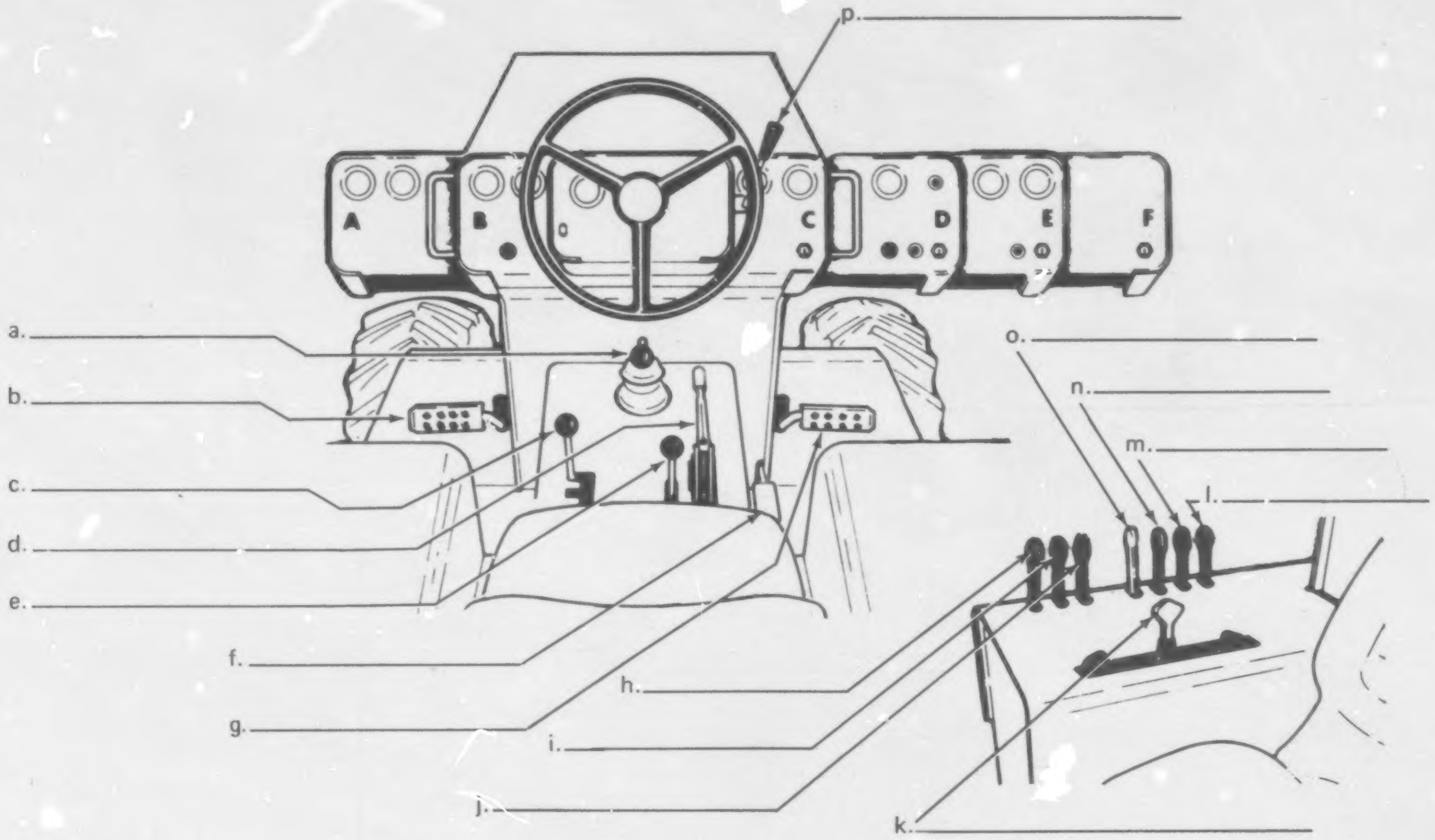
TEST

4. Label basic components of a chain ditcher. Write the correct names in the blanks.


i. ______
j. ______
f. ______
g. ______
h. ______
k. ______
e. ______
d. ______
l. ______
m. ______
c. ______
b. ______
a ______
n. ______

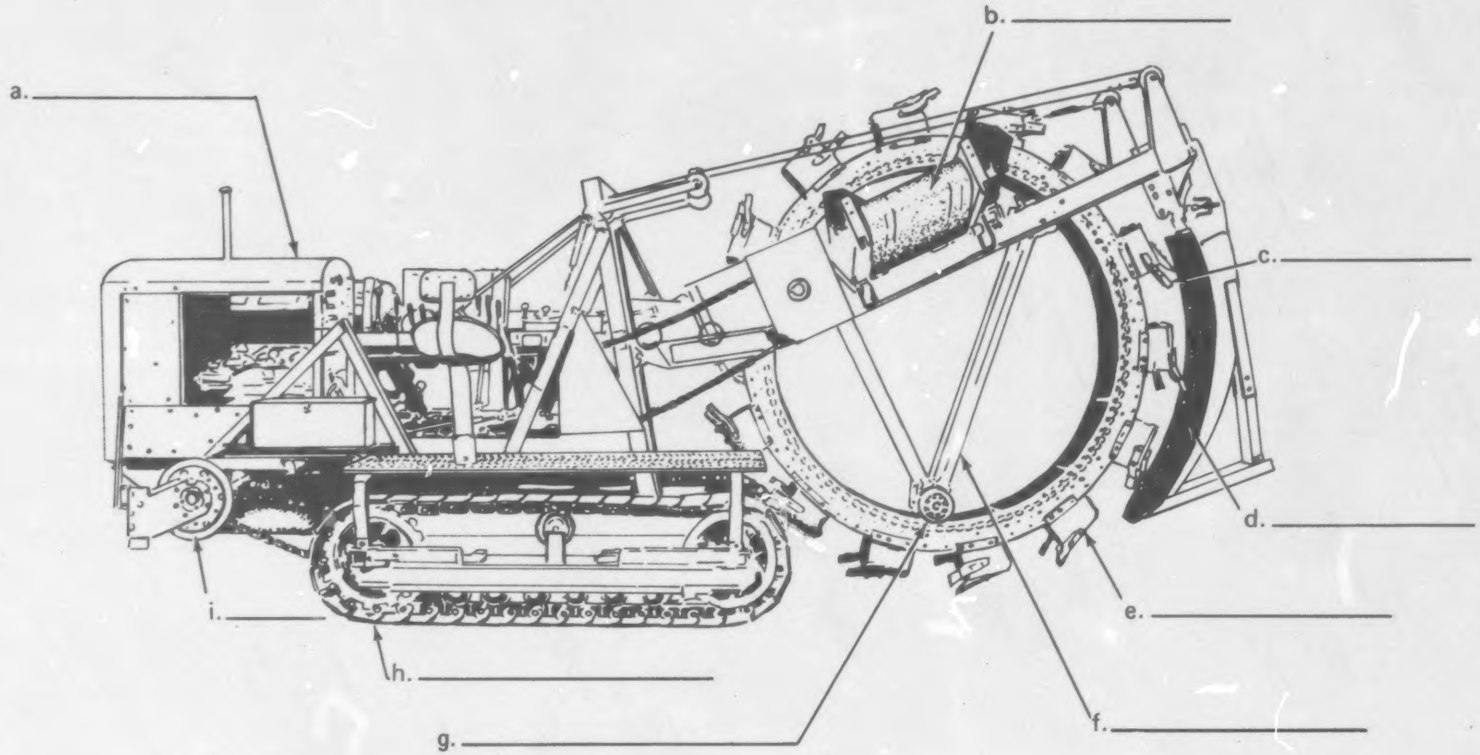
TEST

5. Label controls on a chain ditcher. Write the correct names in the blanks.


p. ____________________
A
B
C
D
E
F
a. ____________________
b. ____________________
c. ____________________
d. ____________________
e. ____________________
f. ____________________
g. ____________________
h. ____________________
i. ____________________
j. ____________________
k. ____________________
l. ____________________
m. ____________________
n. ____________________
o. ____________________

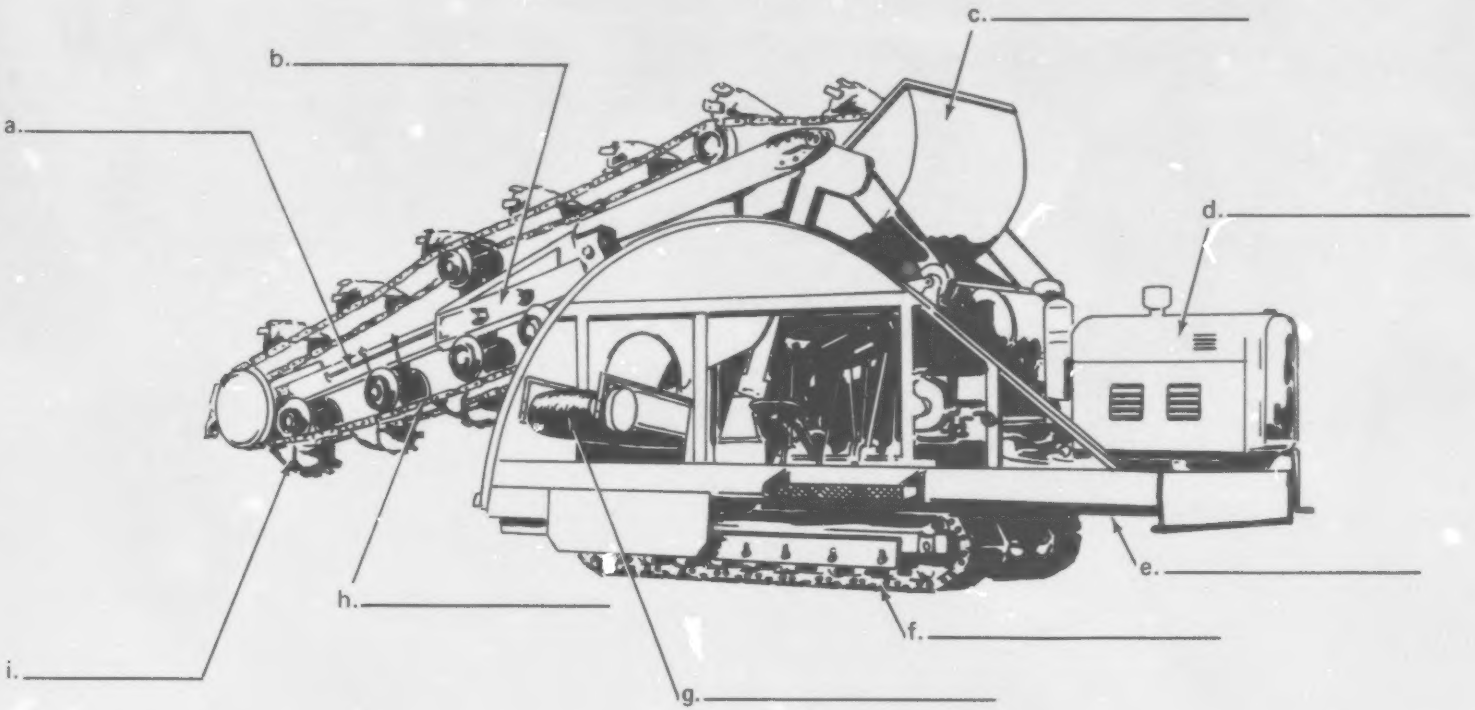
TEST

6. Label basic components of a wheel ditcher. Write the correct names in the blanks.



TEST

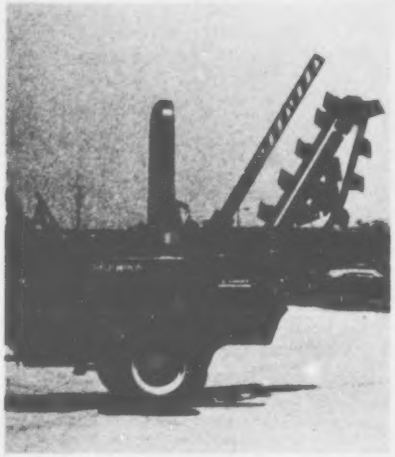
7. Label basic components of a ladder ditcher. Write the correct names in the blanks.



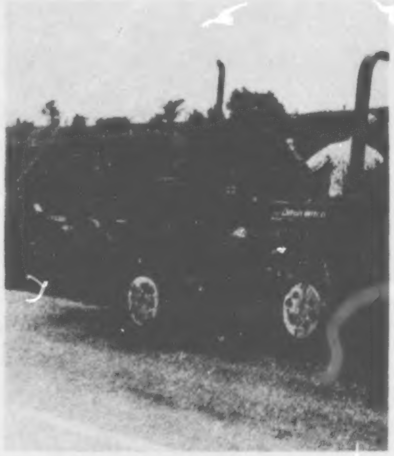
TEST

8. Identify accessories used on trenchers and ditchers. Write the correct names in the blanks.

Earth saw (concrete and rock cutter)
Alligator digging chain
Outriggers
Backhoe
Boring attachment
Vibratory plow
Dozer blade
Cable reel carrier
Drill

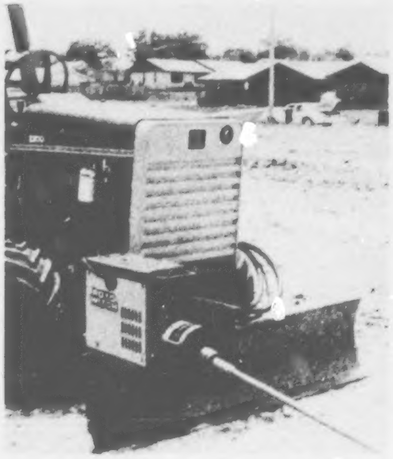


a. ______________________



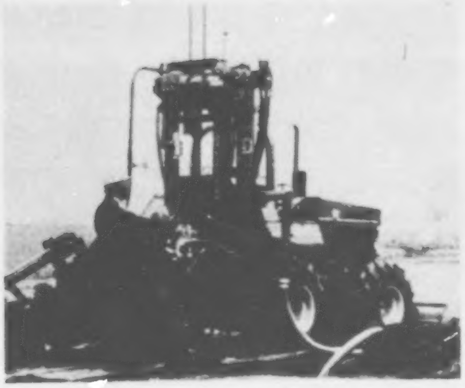
b. ______________________

c. ______________________

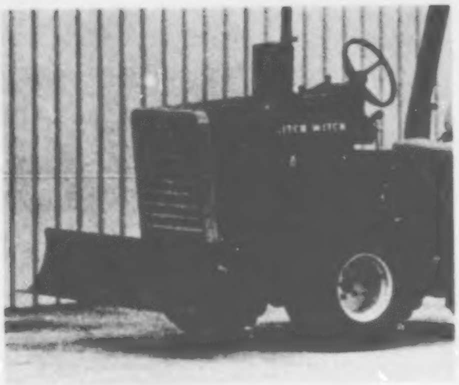


d. ______________________

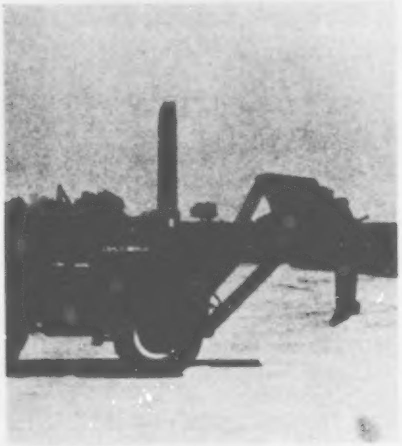
TEST



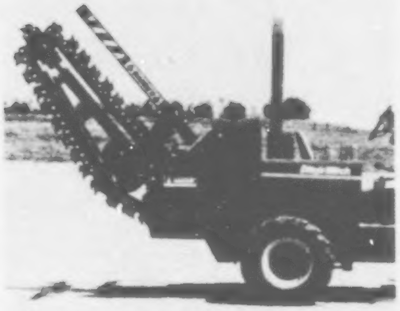
e. ____________________


DITCH WITCH

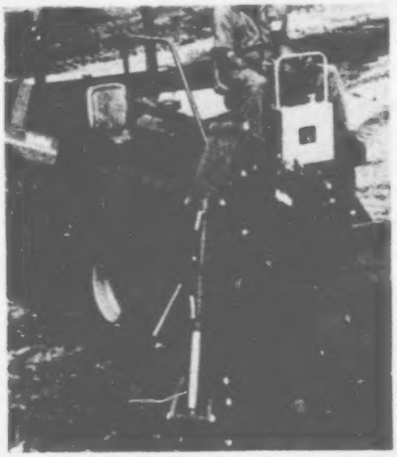
f. ____________________



g. ____________________



h. ____________________



i. ____________________

TEST

9. Describe the purpose of a conveyor belt.

____

____

____

10. Describe the purpose of a shoe post and/or crumber.

____

____

____

11. State twelve safety precautions related to trenchers and/or ditchers.

    a. ______________________________
    b. ______________________________
    c. ______________________________
    d. ______________________________
    e. ______________________________
    f. ______________________________
    g. ______________________________
    h. ______________________________
    i. ______________________________
    j. ______________________________
    k. ______________________________
    l. ______________________________

12. State six suggestions for effective trenching and ditching operations.

    a. ______________________________
    b. ______________________________
    c. ______________________________
    d. ______________________________
    e. ______________________________
    f. ______________________________

TEST

13. Select from the following list items to check when servicing a trencher or ditcher. Write an "X" in the blank before each correct answer.

______a. Fuel level, fuel filters, and sediment bowl (where applicable)

______b. Tires on wheel trencher

______c. Differential

______d. Tracks; clean if necessary

______e. Battery plates

______f. Hydraulic fluid level, filters, hose, lines, fittings, and leaks

______g. Air cleaner filter (element)

______h. Major components and/or accessories

______i. Engine coolant type

______j. Grease fittings

______k. Hydraulic track adjuster

______l. Drive belts for tension and wear

______m. Brake adjustment and condition

______n. Transmission pressure plates

(NOTE: Test questions 14 and 15 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

14. List materials needed to service a trencher or ditcher.

15. Demonstrate the ability to

    a. Perform daily inspection on a ditcher.

    b. Start, warm up, check gauges, and check controls for performance; make final visual inspection and shut down machine.

TRENCHING AND DITCHING MACHINES
UNIT III

ANSWERS TO TEST

1. Description should include the following--Used to dig ditches or trenches, to remove soil, and, in some circumstances, to backfill ditches or trenches

2.
   a. 4
   b. 7
   c. 1
   d. 6
   e. 2
   f. 3
   g. 5
   h. 9
   i. 8

3.
   a. Excavator hoe
   b. Chain
   c. Wheel
   d. Earth saw (concrete and rock cutter)
   e. Ladder
   f. Backhoe

4.
   a. Wheel
   b. Frame tilt
   c. Frame
   d. Dozer blade accessory
   e. Engine
   f. Cab enclosure
   g. ROPS
   h. Seat
   i. Personnel restraint bar
   j. Crumber
   k. Boom
   l. Auger
   m. Fuel tank
   n. Hydraulic fluid sight glass

ANSWERS TO TEST

5. a. Transmission lever
   b. Clutch pedal
   c. Mobile-crowd shift
   d. Emergency/parking brake
   e. Plow shift
   f. Foot throttle pedal
   g. Service brake pedal
   h. Blade lift
   i. Blade angle
   j. Blade tilt
   k. Crowd/speed direction control
   l. Blade steer or crumber slide
   m. Plow lift or crumber shoe
   n. Boom
   o. Rear steer
   p. Hand throttle

6. a. Engine compartment
   b. Conveyor
   c. Bucket fingers
   d. Shoe post and crumber
   e. Bucket
   f. Truck frame
   g. Truck rollers
   h. Crawler unit
   i. Speed traction differential

7. a. Boom extension
   b. Main boom
   c. Combination hood and chute
   d. Engine
   e. Main frame
   f. Tracks
   g. Conveyor
   h. Bucket line chain
   i. Bucket

8. a. Outriggers
   b. Cable reel carrier
   c. Earth saw (concrete and rock cutter)
   d. Boring attachment
   e. Drill
   f. Dozer blade
   g. Vibratory plow
   h. Alligator digging chain
   i. Backhoe

ANSWERS TO TEST

9. Description should include the following--To carry dirt to either side of the machine and leave a windrow

10. Description should include the following--To support back of ditcher wheel; pushes spillage ahead until it is picked up again and rounds and smooths the bottom of ditch

11. Answer should include any twelve of the following

    a. Do not alter or remove safety equipment

    b. Use safety belt

    c. Keep others away from operations

    d. Use extreme caution on slopes and inclines

    e. Wear all required protective clothing and safety gear

    f. Do not touch machine to check for hydraulic leaks

    g. Do not open radiator cap unless engine is cool, then open slowly to release pressure

    h. Use grab irons and steps when mounting and dismounting equipment

    i. Check work area for holes, drop-offs, or obstacles before starting machine

    j. Do not approach overhead or underground power cables with any part of trencher until all local, state, and federal (OSHA) safety requirements have been met

    k. Make sure no one is under, on, or near equipment before starting

    l. Do not overfill fuel tank

    m. Do not fill fuel tank with engine running

    n. Do not fill fuel tank when smoking or when near an open flame

    o. Do not mount or jump from moving equipment

    p. Check, before starting, to be sure you can stop and can control speed and direction

    q. Do not permit riders on equipment

    r. Adjust travel speed to ground conditions when moving

    s. Stay alert to changes in soil conditions

    t. Do not drop a moving chain or wheel to the ground

    u. Do not leave a machine unattended while engine is running

    v. Do not work on, or clean any part of machine with engine running

ANSWERS TO TEST

12. Answer should include any six of the following
    a. Replace digging teeth whenever they are worn
    b. Operate engine at full throttle under load
    c. Do not allow engine to labor
    d. Keep front wheels parallel to basic unit frame for a straight trench
    e. Always use correct length of digging boom
    f. Never turn too sharply
    g. Keep equipment clean
    h. Have equipment serviced regularly
    i. Keep attachment low when traveling on a slope
    j. Travel slowly and cautiously when moving machine
    k. Make turns with boom fully down when possible
13. a, c, d, f, g, h, j, l, m
14. Evaluated to the satisfaction of the instructor
15. Performance skills evaluated to the satisfaction of the instructor

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to identify a crawler side boom and operate controls to perform jobs. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of pipe layers (crawler side booms).
2. Match terms associated with pipe layers (crawler side booms) to their correct definitions.
3. Label controls on a pipe layer (crawler side boom).
4. Label basic components of a pipe layer (crawler side boom).
5. Select from a list safety rules pertaining to pipe layers (crawler side booms).
6. State suggestions for effective pipe layer (crawler side boom) operations.
7. Select from a list items to check when servicing a pipe layer (crawler side boom).
8. Demonstrate the ability to
    a. Start, warm up, check gauges, and test controls for performance; make final visual check.
    b. Cradle pipe, clean pipe, and set dope machine.
    c. Pick up and set 350' section of 36" steel pipe.
    d. Push concrete-covered steel pipe across a lake.

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Provide students with objective sheet.
- B. Provide students with information and job sheets.
- C. Discuss unit and specific objectives.
- D. Discuss information sheet.
- E. Demonstrate and discuss procedures outlined in job sheets.
- F. Stress to students that controls and operating procedures may differ with certain models and different manufacturers.
- G. Provide alternate jobs if job sheets are not practical.
- H. Obtain operator's and maintenance guides for particular machine that is being used for training.
- I. Give test.

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Job sheets
    1. Job Sheet #1--Start, Warm Up, Check Gauges, and Test Controls for Performance; Make Final Visual Check
    2. Job Sheet #2--Cradle Pipe, Clean Pipe, and Set Dope Machine
    3. Job Sheet #3--Pick Up and Set 350' Section of 36" Steel Pipe
    4. Job Sheet #4--Push Concrete-Covered Steel Pipe Across a Lake
- E. Test
- F. Answers to test

SUGGESTED ACTIVITIES

III. Unit references

A. *Lubrication and Maintenance Guide, 572 Pipelayer GEG00641.* East Peoria, Illinois: Caterpillar Tractor Co., n.d.

B. *Midwestern Precision Pipeline Equipment.* Tulsa, Oklahoma: Midwestern Manufacturing Company, n.d.

C. *Operator's Guide, 572 Pipelayer GEG00642*. East Peoria, Illinois: Caterpillar Tractor Co., n.d.

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

INFORMATION SHEET

I. Uses of pipe layers (crawler side booms) (Figure 1)

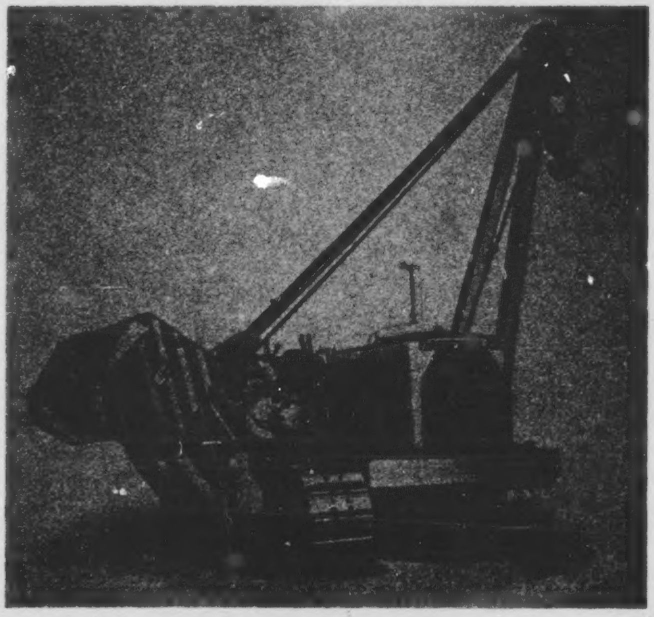
A. Lay pipe and accessories

B. Bend pipe (when equipped with pipe shoes)

C. Backfill pipe ditches (when equipped with backfill blade)

D. Support valves and other accessories while making connections

FIGURE 1



Courtesy of Caterpillar Tractor Company.

II. Terms and definitions

A. Accessories--Attachments used to increase the effectiveness of a machine's use

B. Work cycle--Complete set of operations performed before repeating them

C. Counterweight--Dead or nonworking load attached to side of machine to balance weight carried on the opposite side

INFORMATION SHEET

D. Detent--Device for positioning and holding one mechanical part in relation to another so that the device can be released by applying force to one of the parts

E. Dipstick--Graduated rod for indicating amount of oil or fluid in a system

F. Skids--Blocking used under pipe to support it

G. Cleaning machine--Equipment used to clean pipe and apply primer

H. Dope machine (coating machine)--Equipment used to apply a hot asphalt or tar-type coating and two layers of wrapping material

(NOTE: First layer of wrapping material is usually made of fiberglass, and second layer is usually made of a craft or felt wrapping.)

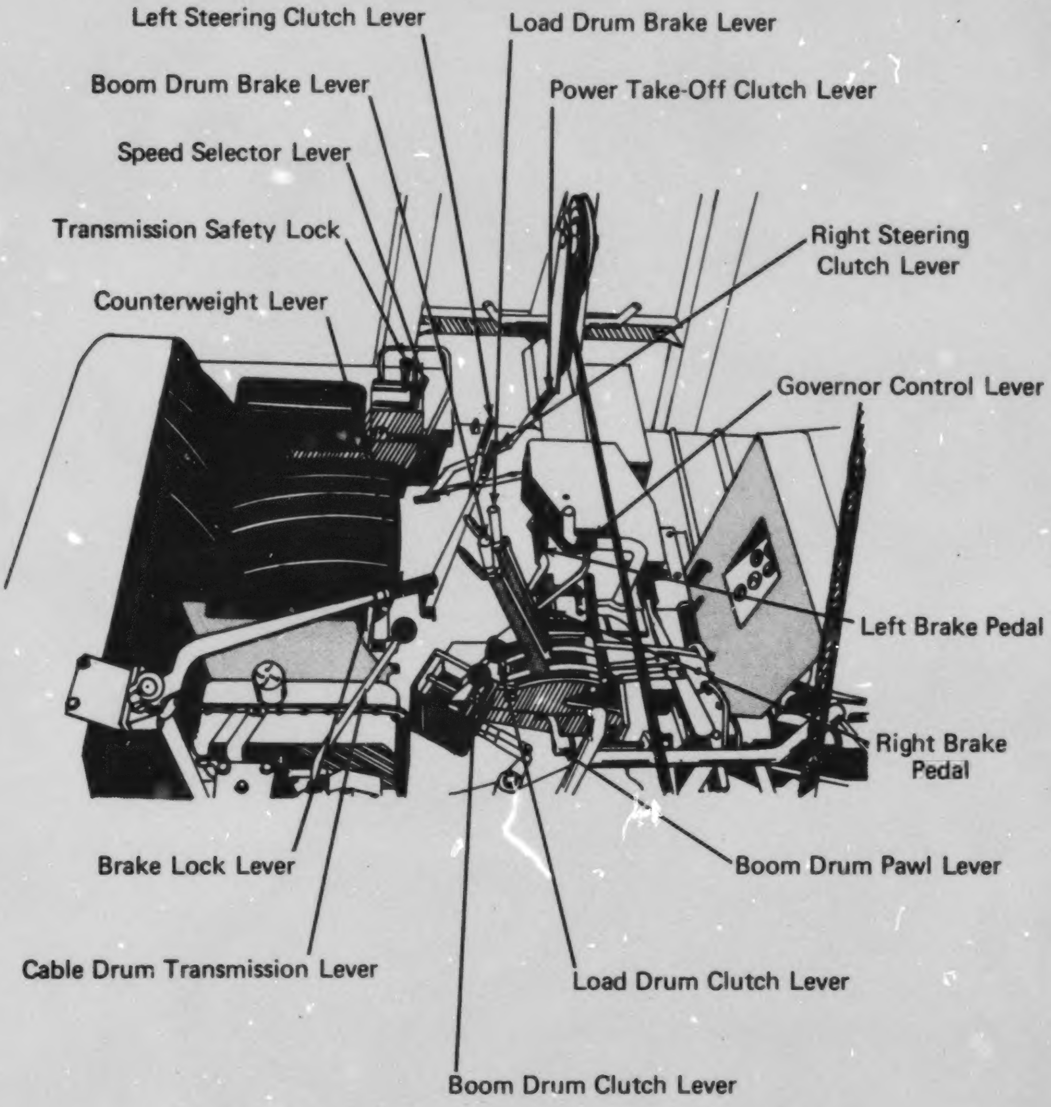
I. Cradle--Used on side boom hoist line to raise and hold pipes suspended in front of pipe-cleaning and pipe dope machines without distorting or damaging pipe

J. Pipe clamp--Used to help align ends of two pipes and hold the two ends together during welding

INFORMATION SHEET

III. Controls on a pipe layer (crawler side boom) (Figure 2)

FIGURE 2

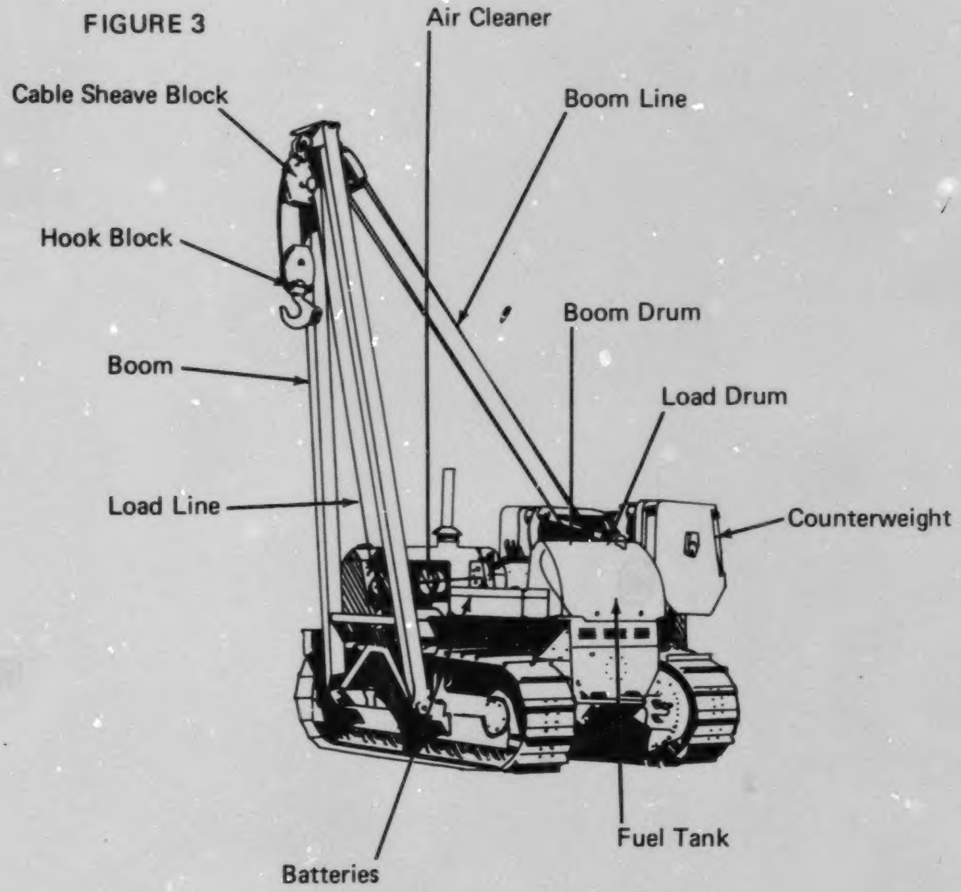

Left Steering Clutch Lever
Load Drum Brake Lever
Boom Drum Brake Lever
Power Take-Off Clutch Lever
Speed Selector Lever
Transmission Safety Lock
Right Steering Clutch Lever
Counterweight Lever
Governor Control Lever
Left Brake Pedal
Right Brake Pedal
Brake Lock Lever
Boom Drum Pawl Lever
Cable Drum Transmission Lever
Load Drum Clutch Lever
Boom Drum Clutch Lever

Used with permission of Caterpillar Tractor Company.

INFORMATION SHEET

IV. Basic components of a pipe layer (crawler side boom) (Figure 3)

FIGURE 3


Air Cleaner
Cable Sheave Block
Boom Line
Hook Block
Boom Drum
Boom
Load Drum
Load Line
Counterweight
Fuel Tank
Batteries

Used with permission of Caterpillar Tractor Company.

V. Safety rules pertaining to pipe layers (crawler side booms)

A. Wear safety items required by job conditions

B. Always lower boom and counterweights before working on them

C. Know and observe hand signals given by signal person

D. Clear obstacles from path of machine

E. Do not remove safety guards and covers

F. Test to be sure all safety devices are functioning properly

INFORMATION SHEET

G. Keep machine clean

H. Do not jump from machine

I. Do not mount or dismount a moving machine

J. Do not leave machine running unattended

K. Never allow riders on machine

L. Do not operate with worn or damaged cable

M. Do not move machine until all personnel are clear

N. Be very cautious around power lines and other overhead obstructions

O. Check overhead clearances before raising boom

P. Wear gloves when handling cables

VI. Suggestions for effective pipe layer (crawler side boom) operations

(NOTE: The following are suggestions to improve operating efficiency.)

A. Keep machine clean

B. Service equipment regularly

C. Calculate and plan operations before starting

D. Observe all safety rules and regulations

E. Set up work cycle so that it will be as short as possible

F. Maintain a firm footing before attempting to lift any load

G. Avoid jerky operations

H. Avoid unnecessary up and down booming

I. Locate machine so that boom will not make contact with power lines and/or overhead obstructions

VII. Items to check when servicing a pipe layer (crawler side boom)

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Visual inspection for broken, worn, or missing parts, and leaks

B. Engine oil level, filter, lines, and hoses

C. Air cleaner filter (element)

INFORMATION SHEET

D. Engine coolant level, radiator cap, hose, and radiator

(CAUTION: Do not remove radiator cap unless engine is cool; then open slowly to release pressure.)

E. Fuel level, fuel filters, and sediment bowl (where applicable)

F. Battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Exhaust system

H. Hydraulic fluid level, filters, hose, lines, fittings, and leaks

I. Transmission fluid level

J. Transmission pressure line and breather

K. Brake adjustment and condition

L. Brake master cylinder fluid level

M. Clutch for proper adjustment

N. Drive belts for tension and wear

O. Wiring, insulation, and connections

P. Grease fittings

Q. Tracks, track drive chains, and pads

R. All safety devices

S. Windshield wipers (where applicable)

T. Major components and/or accessories

U. Counterweights and hydraulic rams

V. Gauges and controls for proper functioning

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

JOB SHEET #1--START, WARM UP, CHECK GAUGES, AND TEST CONTROLS FOR PERFORMANCE; MAKE FINAL VISUAL CHECK

I. Equipment and materials

  A. Crawler side boom

  B. Pipe layer accessory

II. Procedure

  A. Mount machine, using steps and grab irons

  B. Adjust seat

  C. Depress both brake pedals

  D. Push brake lock on

  E. Push speed selector to neutral

  F. Pull safety lock on

  G. Push power takeoff clutch lever to disengage position

  H. Turn disconnect switch to "on" position

  (NOTE: Never turn disconnect switch off with engine running.)

  I. Adjust governor control to proper starting position

  J. Push in and turn switch to start

  (CAUTION: Never operate starter more than 20-30 seconds at a time, if engine fails to start, wait 2 minutes, then try again.)

  K. Release switch when engine starts

  L. Determine that all gauges are functioning properly

  M. Allow engine to warm up (5 minutes in summer; 10 to 15 minutes in winter)

  N. Unlock brakes

  O. Depress both brake pedals to release brake lock

  P. Push transmission control safety lock to "off" position

  Q. Raise boom

JOB SHEET #1

R. Manipulate controls to move forward and backward

S. Manipulate controls to turn left and right

T. Manipulate controls to lower and raise counterweight

U. Manipulate controls to lower and raise boom

V. Manipulate controls to lower and raise hook block

W. Reduce engine speed

X. Push selector control to neutral

Y. Depress brake pedals

Z. Push brake lock to "on" position, then release brake pedals

AA. Pull up on selector safety lock

BB. Lower boom and counterweight

CC. Push governor control to low idle for 30 seconds

DD. Push governor control past detent to stop engine

EE. Turn disconnect switch off and remove key

FF. Dismount machine

GG. Make visual check for leaks

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

JOB SHEET #2--CRADLE PIPE, CLEAN PIPE, AND SET DOPE MACHINE

I. Equipment and materials

   A. Three pipe layers

   B. Slings

   C. One 600' section of 36" steel pipe

   D. Two sets of cradles

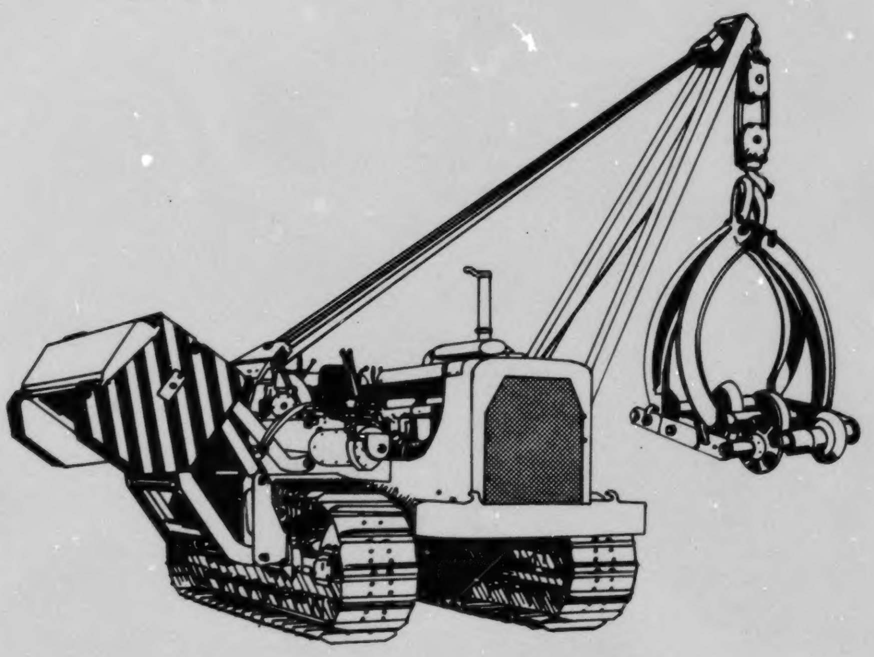
   E. Pipe cleaning machine

   F. Dope machine

II. Procedure

   A. Move side boom into position to pick up cradle (Figure 4)

FIGURE 4



JOB SHEET #2

B. Raise hoist line enough for cradle to clear all obstructions

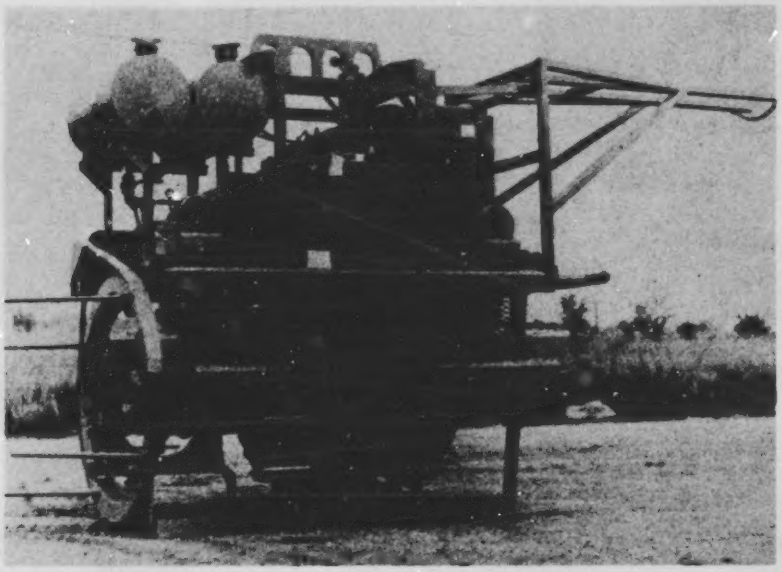
C. Move side boom to end of pipe

D. Lower hoist line so that cradle can be fitted over end of pipe

E. Raise hoist line until pipe is off the ground enough for cleaning machine to operate

F. Move second side boom into position to pick up cleaning machine (Figure 5)

FIGURE 5



G. Lower boom until sling centers over cleaning machine

H. Lower hoist line enough so that it can be attached to cleaning machine

I. Raise hoist line enough for cleaning machine to clear all obstacles

J. Move side boom to end of pipe

K. Lower hoist line so that cleaning machine can be fitted over end of pipe

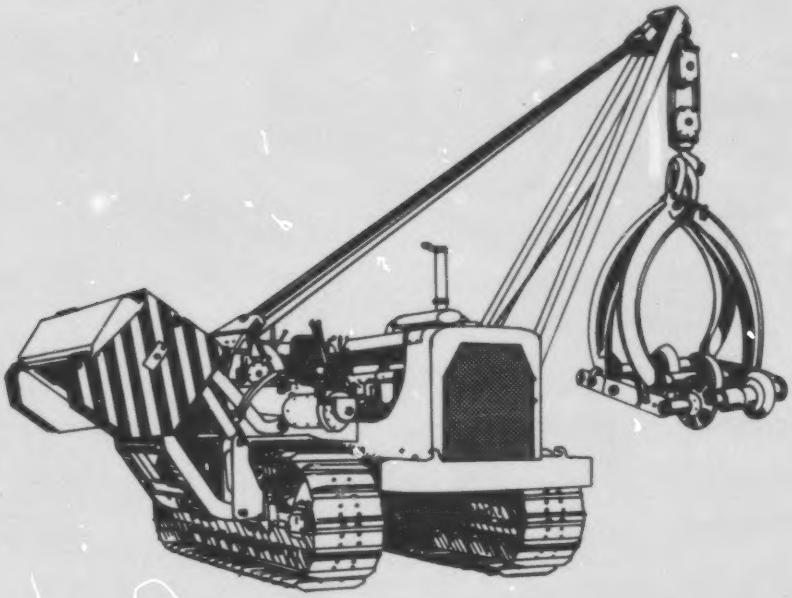
(NOTE: After cleaning machine is set, unhook hoist line and start cleaning machine. Machine will clean and prime pipe in one operation.)

JOB SHEET #2

L. Move this side boom into position to pick up second cradle (Figure 6)

(NOTE: When using a dope machine, it is necessary to use two cradles.)

FIGURE 6



M. Lower hoist line enough so that it can be attached to cradle

N. Raise hoist line enough for cradle to clear all obstacles

O. Move side boom to end of pipe

P. Lower hoist line enough for cradle to be fitted over end of pipe

Q. Move cradle forward, then raise hoist line to take up slack

(NOTE: By this time, the first side boom and cradle will have reached opposite ends of pipe.)

JOB SHEET #2

R. Lower hoist line enough so that end of pipe can rest on skids

S. Remove cradle from pipe

T. Lower hoist line so that cradle can be removed

U. Raise hoist line and move side boom to end of pipe to remove cleaning machine

V. Lower hoist line over cleaning machine and attach hoist line to cleaning machine

W. Remove cleaning machine from end of pipe

X. Move cleaning machine away from pipe and lower hoist line so that the machine can be removed

Y. Return to cradle and lower hoist line so that cradle can be attached

Z. Move side boom to opposite end of pipe

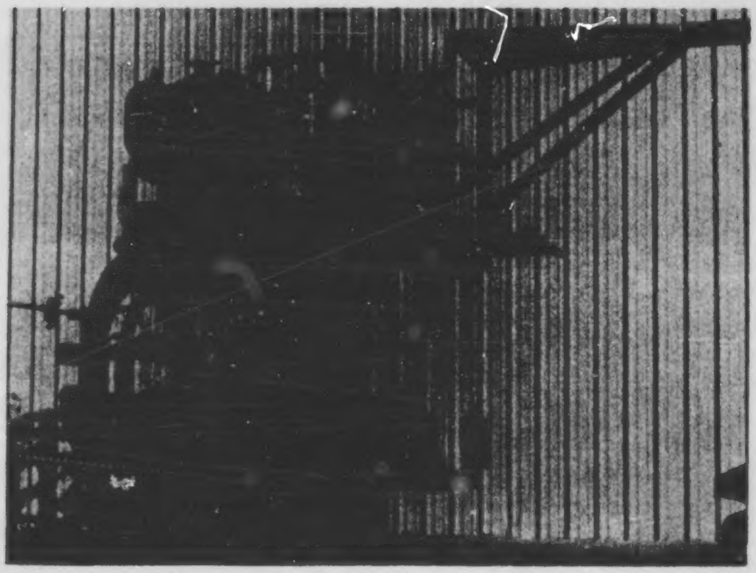
AA. Lower hoist line enough for cradle to be fitted over end of pipe

BB. Move cradle forward, then raise hoist line to take up slack

CC. Raise hoist line on both side booms until pipe is high enough for dope machine to be attached

DD. Move third side boom into position to pick up dope machine (Figure 7)

FIGURE 7



JOB SHEET #2

EE. Lower boom until hoist line centers over cradle

FF. Lower hoist line enough so that it can be attached to dope machine

GG. Raise hoist line enough for dope machine to clear all obstacles

HH. Move side boom to end of pipe

II. Lower hoist line so that cradle can be fitted over end of pipe

(NOTE: After dope machine is set, unhook hoist line and start machine. Machine will dope pipe and make a double wrap of paper in one operation.)

JJ. Move side boom to opposite end of pipe ready to remove dope machine when it has completed doping pipe

KK. Remove first cradle from pipe when it reaches end of pipe

LL. Set cradle aside and attach a belt to side boom

MM. Move side boom and attach belt to pipe in a location just behind dope machine; take up slack to hold pipe

(NOTE: It is necessary for this machine to hold pipe while second cradle and dope machine are removed.)

NN. Remove second cradle from pipe when it reaches end of pipe and move out of way

OO. Move third side boom into position to remove dope machine

PP. Lower hoist line on first side boom and set pipe on skids

QQ. Remove belt from pipe and move side boom away

(NOTE: Pipe is now ready to be set.)

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

JOB SHEET #3--PICK UP AND SET 350' SECTION OF 36" STEEL PIPE

I. Equipment and materials

A. Two pipe layers

B. Two belts

C. One 350' section of 36" steel pipe

(NOTE: Number of pipe layers is determined by weight of pipe and conditions.)

II. Procedure

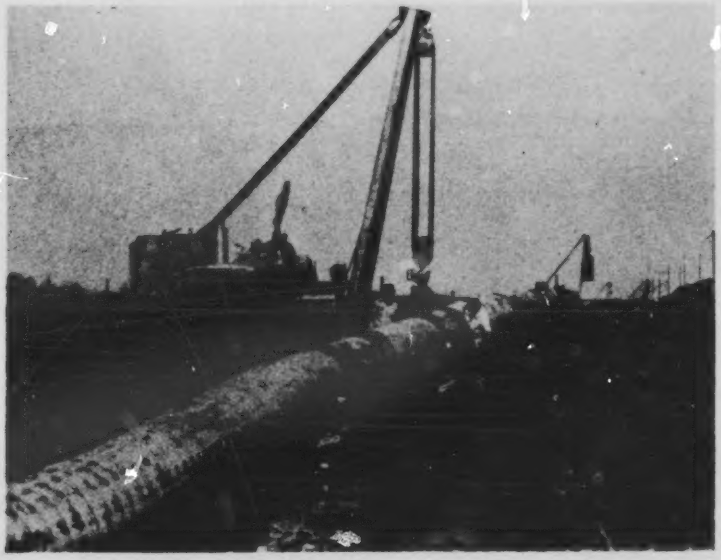
A. Move side booms into position

(NOTE: When positioning machines, position them so that there will be approximately twice the distance between the machines as there is from the machines to the end of pipe.)

B. Lower boom until belt centers over pipe

C. Lower hoist line enough so that belt can be placed around pipe and attached to hoist line (Figure 8)

FIGURE 8

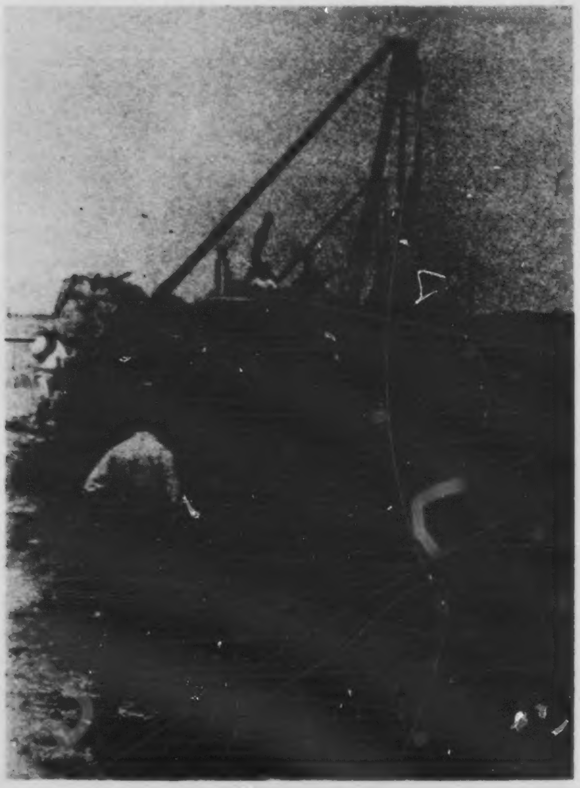


JOB SHEET #3

D. Raise hoist line when signal is given to raise pipe (Figure 9)

(NOTE: If pipe does not balance, it may be necessary to relocate point of lifts.)

FIGURE 9



E. Move machine forward when signal is given

(NOTE: Operator must be alert to the signals given by the signal person at all times.)

F. Continue moving toward ditch until proper distance is reached

(NOTE: While moving forward, boom should be lowered and hoist line raised at the same time to keep pipe from hitting the ground.)

(CAUTION: A safe distance from ditch must be maintained to keep edge of ditch from caving in.)

G. Manipulate controls until pipe is centered over ditch

JOB SHEET #3

H. Lower pipe on signal

(CAUTION: Keep pipe in center of ditch to avoid rubbing sides of ditch and damaging coating on pipe.)

I. Continue lowering pipe until correct height is reached to butt pipe against existing pipe

J. Walk pipe layers back until ends of pipe are butted together; manipulate controls to align pipe correctly

(CAUTION: Approximately the same amount of pressure must be maintained completely around the pipe joint; if there is more pressure on one side, the pipe clamps will not be able to line them up properly.)

K. Lower hoist lines until there is enough slack to unhook belts

(NOTE: Pipe layer holding free end of pipe will maintain its position until next section is set and welded.)

L. Disconnect belts from around pipe

M. Travel to next section of pipe and repeat procedure

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

JOB SHEET #4--PUSH CONCRETE-COVERED STEEL PIPE ACROSS A LAKE

I. Equipment and materials

- A. Eight pipe layers
- B. Eight belts
- C. Four 475' sections of 36" concrete-covered steel pipe

  (NOTE: Number of pipe layers is determined by weight of pipe and conditions.)

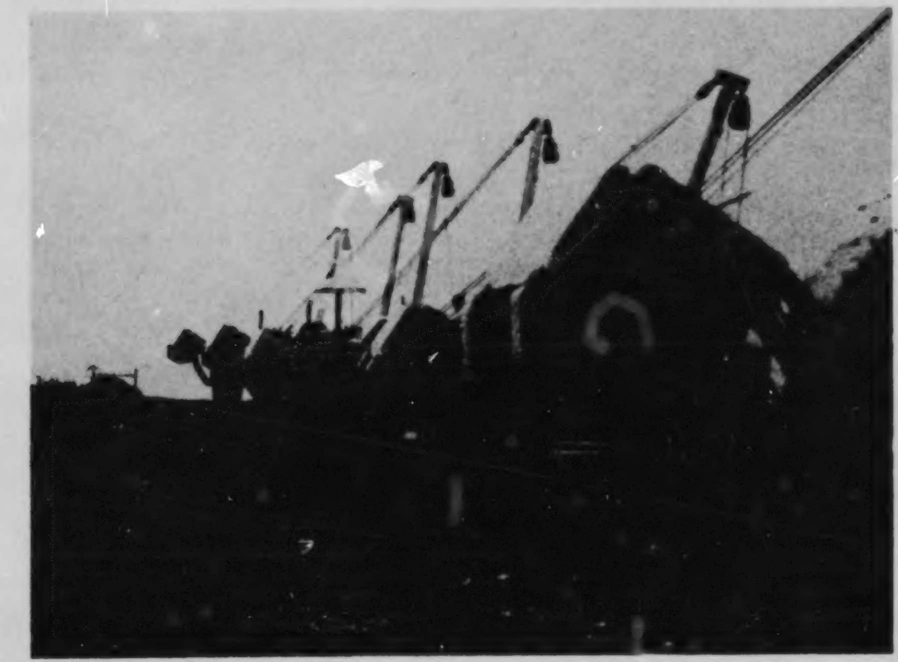
- D. Grinder and wire brush
- E. Primer, dope, and wrapping material
- F. Metal form and concrete

II. Procedure

- A. Move seven side booms into position to pick up pipe

  (NOTE: Side booms are positioned approximately equal distances along length of pipe; see Figure 10.)

FIGURE 10

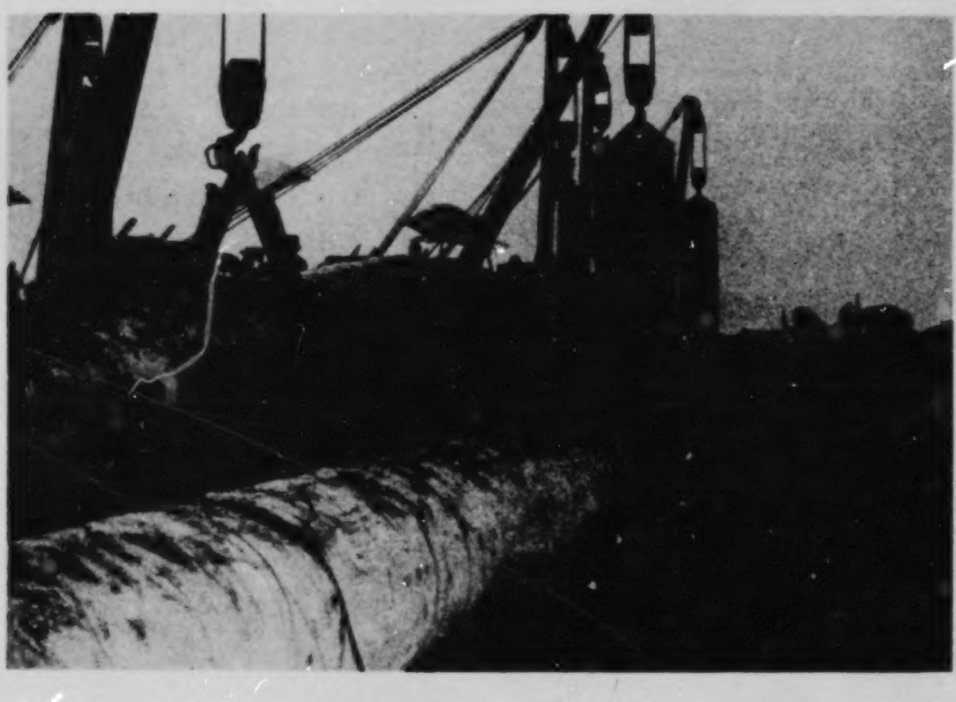


- B. Lower booms until belts center over pipe

JOB SHEET #4

C. Lower hoist line enough so that belt can be placed around pipe and attached to hoist line (Figure 11)

FIGURE 11



D. Raise hoist line when signal is given to raise pipe

(NOTE: Signal person will be located near front end of pipe and first side boom; as signals are given, each operator also gives a hand signal so that the operators behind can each pick up the signals in case they cannot see the signal person.)

E. Continue to raise pipe until signal is given to hold

F. Move forward on signal until first side boom reaches edge of water

(NOTE: When first side boom reaches edge of water, signal is given to stop; and immediately first operator lowers hoist line to put slack in belt. As soon as there is enough slack, one of the ground crew who has been riding pipe disconnects belt and moves to second side boom belt; first side boom immediately moves out and into position on second section of pipe where its belt will be connected.)

G. Stop when signal is given

H. Move forward on signal until second side boom reaches edge of water

JOB SHEET #4

I. Lower hoist line so that belt can be disconnected (Figure 12)

FIGURE 12

J. Move side boom away and into position on second pipe

K. Continue this procedure until there is only one side boom connected to the pipe (Figure 13)

(NOTE: Last side boom will maintain its position until next section is set and welded.)

FIGURE 13

JOB SHEET #4

L. Move eighth side boom into position to take place of the one still attached to first pipe

M. Raise hoist line when signal is given to raise pipe

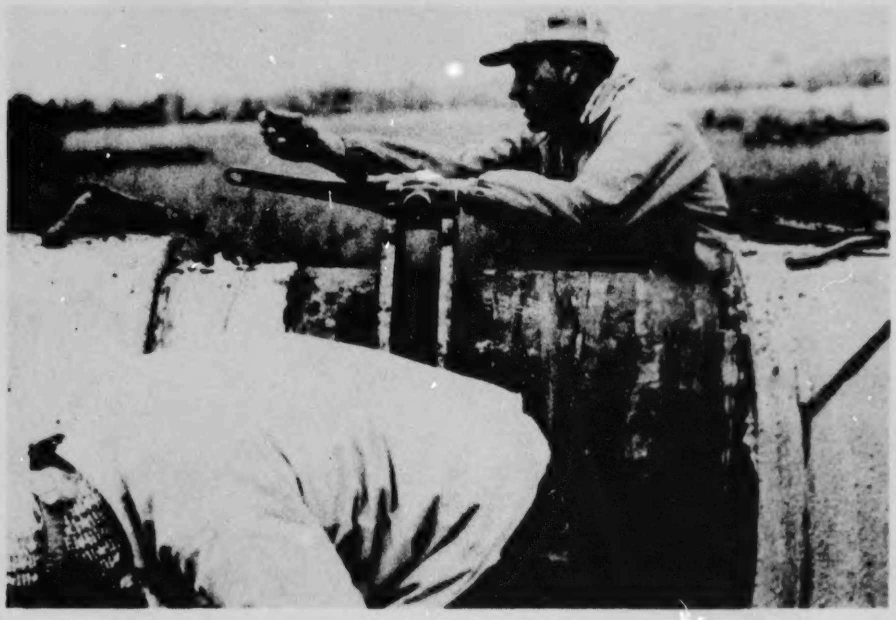
N. Continue to raise pipe until signal is given to hold

O. Move on signal to line up second pipe with first pipe

P. Move forward on signal until signal is given to stop when pipes are nearly butted together (Figure 14)

(NOTE: At this time, both pipes may have to be manipulated to maintain approximately the same amount of pressure completely around the pipe joint; if there is more pressure on one side, the pipe clamps will not be able to line them up properly. Welding and X-ray operations will be done by specialists.)

FIGURE 14



Q. Hold a steady position while weld is being made and X rays are taken

(NOTE: After weld is made and X rays are taken, the joint is cleaned, primed, doped, and double-wrapped with material, then, a piece of metal is strapped around the pipe [as a form] to hold the concrete that will be poured in.)

R. Raise hoist line when signal is given to raise pipe

S. Continue to raise pipe until signal is given to hold

JOB SHEET #4

T. Disconnect belt from pipe on first side boom and move it away

U. Continue these procedures until all four sections of pipe have been pushed into lake

(NOTE: To avoid moving pipe away from ditch, it may be necessary for the end of pipe to be lowered to fill partially with water so that it will lower itself into the ditch after the second pipe has been pushed into the lake; see Figures 15 and 16.)

FIGURE 15

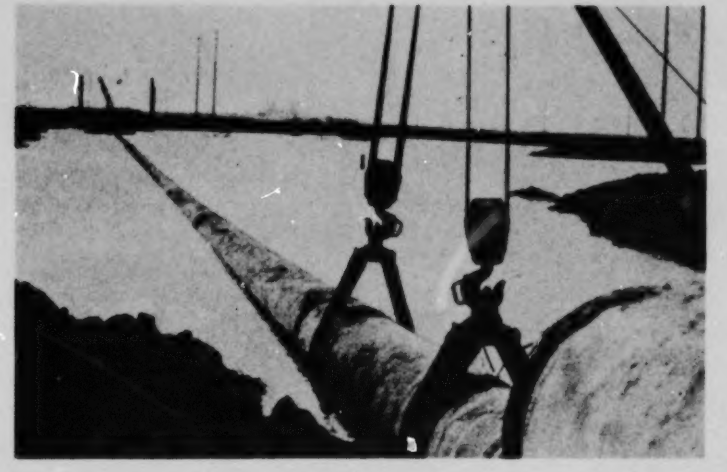
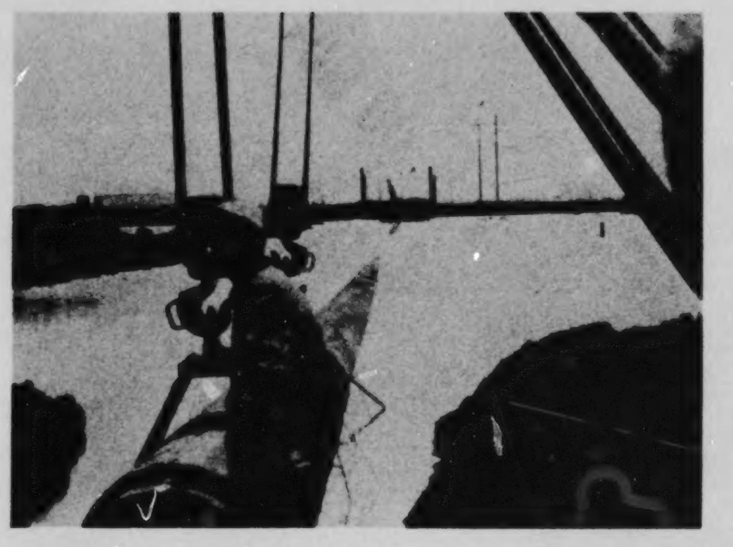


FIGURE 16



PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

TEST

NAME ______________________________ SCORE ____________________

1. List three uses of pipe layers (crawler side booms).

   a. ____

   b. ____

   c. ____

2. Match terms associated with pipe layers (crawler side booms) to their correct definitions. Write the correct numbers in the blanks.

_____a. Attachments used to increase the effectiveness of a machine's use

_____b. Complete set of operations performed before repeating them

_____c. Dead or nonworking load attached to side of machine to balance weight carried on the opposite side

_____d. Device for positioning and holding one mechanical part in relation to another so that the device can be released by applying force to one of the parts

_____e. Graduated rod for indicating amount of oil or fluid in a system

_____f. Blocking used under pipe to support it

_____g. Equipment used to clean pipe and apply primer

_____h. Equipment used to apply a hot asphalt or tar-type coating and two layers of wrapping material

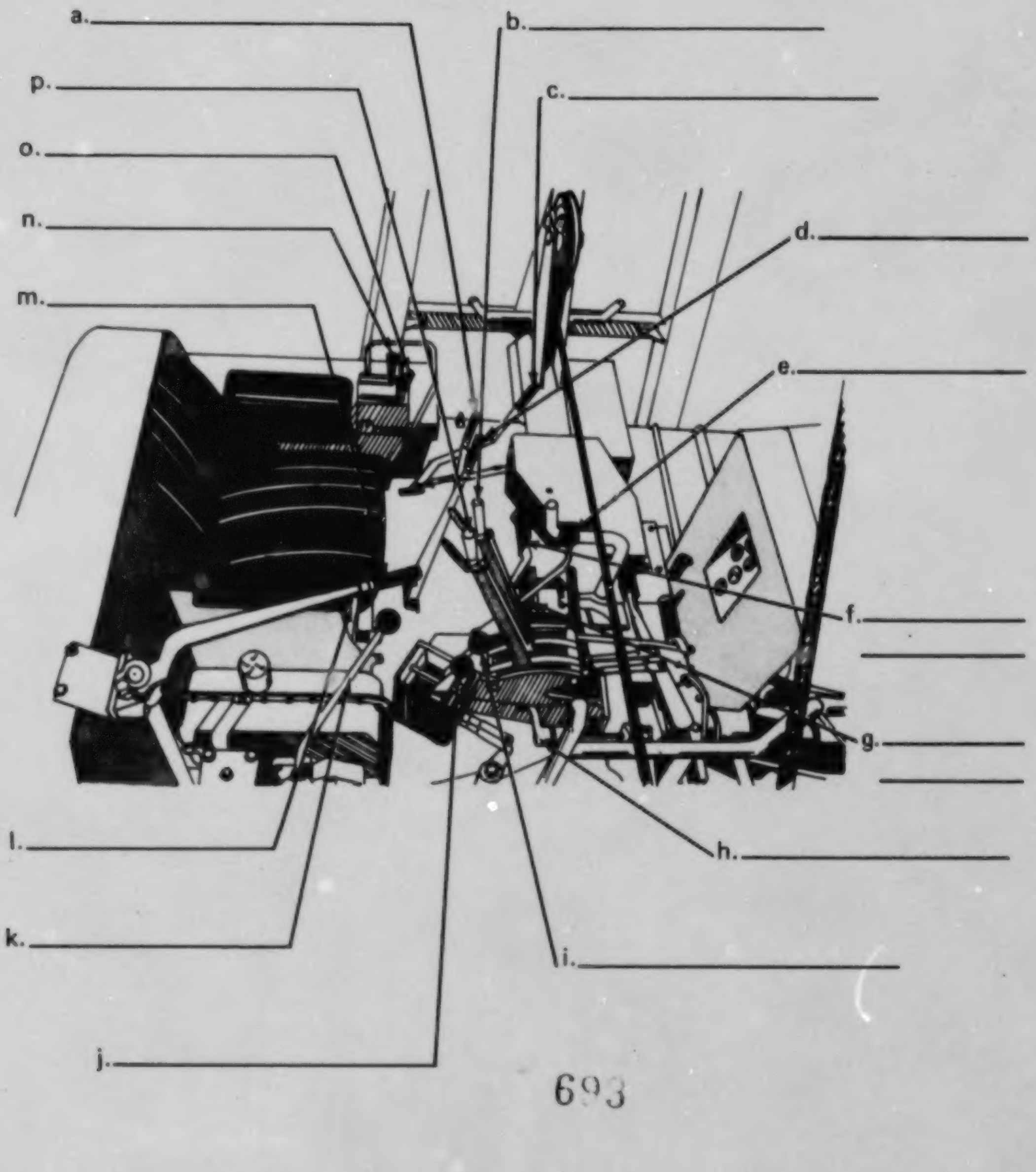
_____i. Used on a side boom hoist line to raise and hold pipe suspended in front of pipe-cleaning and pipe dope machines without distorting or damaging pipe

_____j. Used to help align ends of two pipes and hold the two ends together during welding

1. Detent
2. Counterweight
3. Dipstick
4. Accessories
5. Work cycle
6. Cradle
7. Cleaning machine
8. Pipe clamp
9. Dope machine (coating machine)
10. Skids

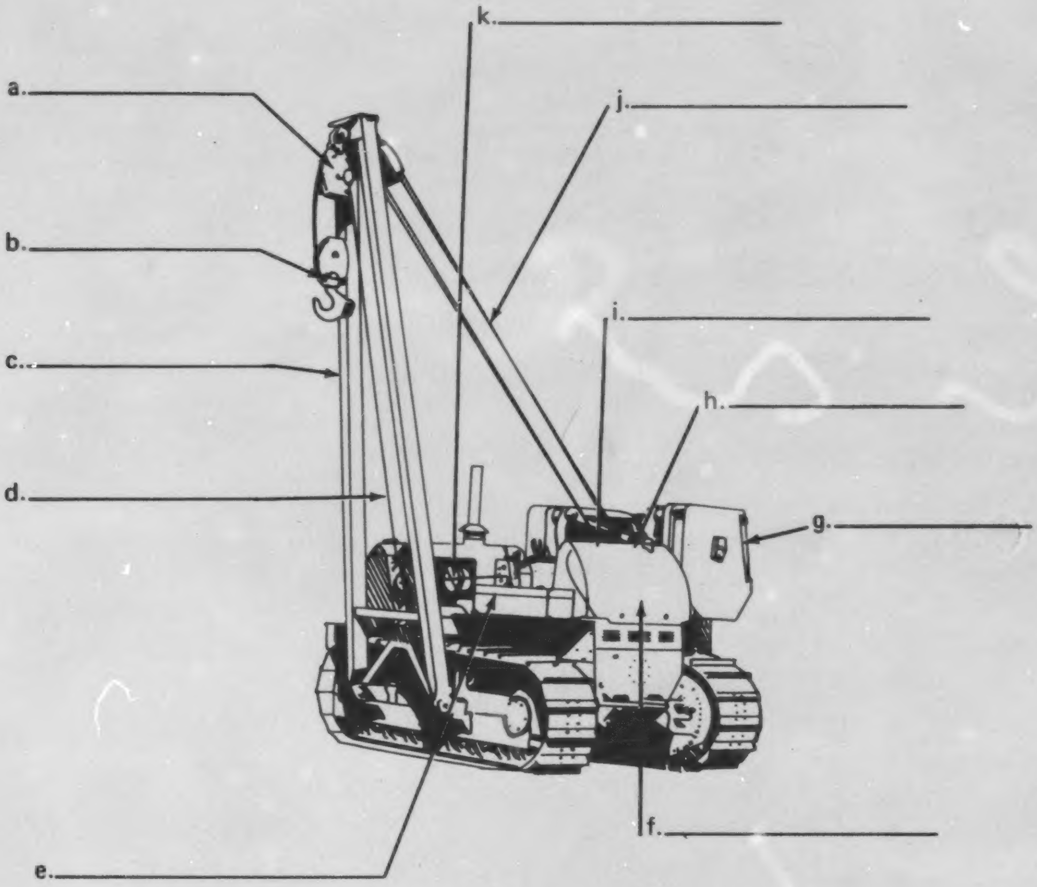
TEST

3. Label controls on the pipe layer (crawler side boom) illustrated below. Write the correct names in the blanks.


a.
b.
p.
c.
o.
n.
d.
m.
e.
f.
g.
l.
h.
k.
i.
j.

TEST

4. Label basic components of the pipe layer (crawler side boom) illustrated below. Write the correct names in the blanks.



5. Select from the following list safety rules pertaining to pipe layers (crawler side booms). Write an "X" in the blank before each correct answer.

_____a. Do not mount or dismount a moving machine

_____b. Know and observe hand signals given by signal person

_____c. Never allow riders on machine

_____d. Do not move machine until all personnel are clear

_____e. Wear safety items required by job conditions

_____f. Never operate machine at full throttle

TEST

______g. Always lower boom and counterweights before moving

______h. Be very cautious around power lines and other overhead obstructions

______i. Do not leave machine running unattended

______j. Wear safety items only when operating machine

6. State six suggestions for effective pipe layer (crawler side boom) operations.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

7. Select from the following list items to check when servicing a pipe layer (crawler side boom). Write an "X" in the blank before each correct answer.

______a. Gasoline level

______b. Hydraulic fluid level, filters, hose, lines, fittings, and leaks

______c. Tracks, track drive chains, and pads

______d. Boom angle

______e. Drive belts for tension and wear

______f. Swing control

______g. Brake master cyliner fluid level

______h. Battery electrolyte level, battery cables, and connectors

______i. Engine oil level, filter, lines, and hoses

______j. Transmission fluid level

______k. Grease fittings

______l. Air pressure in bull wheel

______m. Windshield wipers (where applicable)

______n. Load line tension

TEST

(NOTE: Test question 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Start, warm up, check gauges, and test controls for performance; make final visual check.

   b. Cradle pipe, clean pipe, and set dope machine.

   c. Pick up and set 350' section of 36" steel pipe.

   d. Push concrete-covered steel pipe across a lake.

PIPE LAYER
(CRAWLER SIDE BOOM)
UNIT IV

ANSWERS TO TEST

1. Answer should include any three of the following
   - a. Lay pipe and accessories
   - b. Bend pipe (when equipped with pipe shoes)
   - c. Backfill pipe ditches (when equipped with backfill blade)
   - d. Support valves and other accessories while making connections
2. a. 4
   - b. 5
   - c. 2
   - d. 1
   - e. 3
   - f. 10
   - g. 7
   - h. 9
   - i. 6
   - j. 8
3. a. Left steering clutch lever
   - b. Load drum brake lever
   - c. Power take-off clutch lever
   - d. Right steering clutch lever
   - e. Governor control lever
   - f. Left brake pedal
   - g. Right brake pedal
   - h. Boom drum pawl lever
   - i. Load drum clutch lever
   - j. Boom drum clutch lever
   - k. Cable drum transmission lever
   - l. Brake lock lever
   - m. Counterweight lever
   - n. Transmission safety lock
   - o. Speed selector lever
   - p. Boom drum brake lever
4. a. Cable sheave block
   - b. Hook block
   - c. Boom
   - d. Load line
   - e. Batteries
   - f. Fuel tank
   - g. Counterweight
   - h. Load drum
   - i. Boom drum
   - j. Boom line
   - k. Air cleaner

ANSWERS TO TEST

5. a, b, c, d, e, h, i

6. Answer should include any six of the following

   a. Keep machine clean

   b. Service equipment regularly

   c. Calculate and plan operations before starting

   d. Observe all safety rules and regulations

   e. Set up work cycle so that it will be as short as possible

   f. Maintain a firm footing before attempting to lift any load

   g. Avoid jerky operations

   h. Avoid unnecessary up and down booming

   i. Locate machine so that boom will not make contact with power lines and/or overhead obstructions

7. b, c, e, g, h, i, j, k, m

8. Performance skills evaluated to the satisfaction of the instructor

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to identify controls on a hydraulic crawler excavator and operate an excavator to perform different types of jobs. This knowledge will be shown by completing assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of hydraulic crawler excavators.
2. Match terms associated with hydraulic crawler excavators to their correct definitions.
3. Label basic components of a hydraulic crawler excavator.
4. Label controls on a hydraulic crawler excavator.
5. State safety precautions related to hydraulic crawler excavators.
6. State suggestions for effective hydraulic crawler excavator operations.
7. Select from a list items to check when servicing a hydraulic crawler excavator.
8. List materials necessary to service a hydraulic crawler excavator.
9. Demonstrate the ability to
    a. Start, warm up, check gauges, and check controls for performance; make final visual inspection and shut down machine.
    b. Service a hydraulic crawler excavator.
    c. Dig a straight-line ditch, and load a haul truck.
    d. Load a hydraulic crawler excavator for travel.
    e. Operate excavator to set pipe.
    f. Operate excavator in unstable soil, using mats.
    g. Operate excavator, using trench box.

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information, assignment, and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information and assignment sheets.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Obtain operator's service guide for type of equipment being used.

   G. Take students on field trip to observe equipment performing a job.

   H. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Assignment sheets

      1. Assignment Sheet #1--Label Controls on a Hydraulic Crawler Excavator

      2. Assignment Sheet #2--List Materials Necessary to Service a Hydraulic Crawler Excavator

   E. Answers to assignment sheets

   F. Job sheets

      1. Job Sheet #1--Start, Warm Up, Check Gauges, and Check Controls for Performance; Make Final Visual Inspection and Shut Down Machine

      2. Job Sheet #2--Service a Hydraulic Crawler Excavator

      3. Job Sheet #3--Dig a Straight-Line Ditch, and Load a Haul Truck

      4. Job Sheet #4--Load a Hydraulic Crawler Excavator for Travel

SUGGESTED ACTIVITIES

5. Job Sheet #5--Operate Excavator to Set Pipe

6. Job Sheet #6--Operate Excavator in Unstable Soil, Using Mats

7. Job Sheet #7--Operate Excavator, Using Tench Box

G. Test

H. Answers to test

III. Unit references

A. Nichols, Herbert L. *Moving The Earth*, 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

B. *Operating Instructions (325H)*. South Milwaukee, Wisconsin: Bucyrus-Erie Company Sales Development Department, n.d.

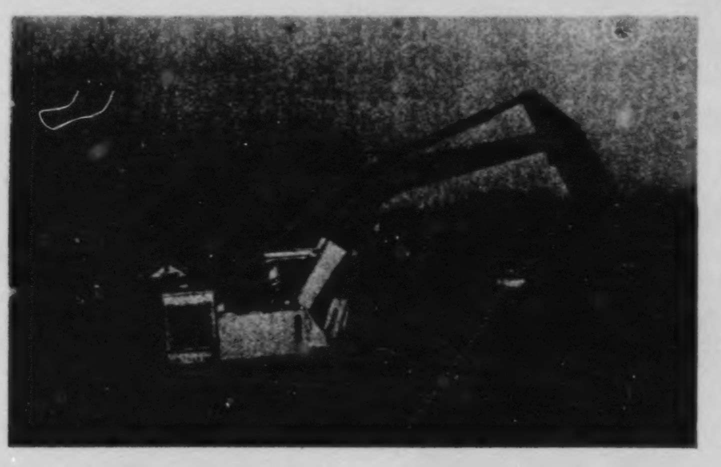
HYDRAULIC CRAWLER EXCAVATORS
UNIT V

INFORMATION SHEET

I. Uses of hydraulic crawler excavators (Figure 1)

EXAMPLE:

FIGURE 1



- A. Ditching
- B. Excavating basements and sunken pits
- C. Mud excavation
- D. Hoisting
- E. Demolition
- F. Logging
- G. Scrap handling
- H. Install shoring

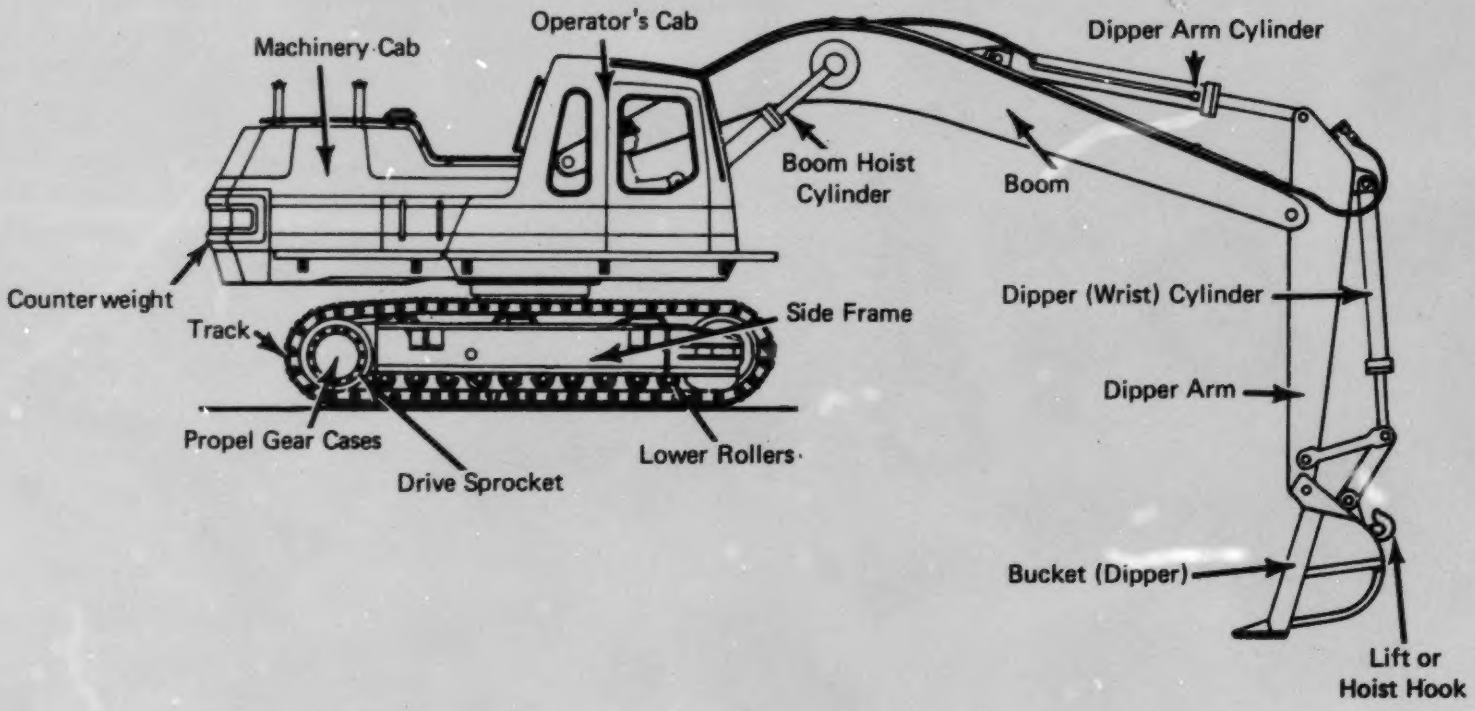
II. Terms and definitions

- A. Demolition--Destruction or scrapping
- B. Curl--To tilt
- C. Work cycle--Complete set of operations performed before repeating them
- D. Counterweight--Dead or nonworking load attached to one end or side of a machine to help improve balance

INFORMATION SHEET

III. Basic components of a hydraulic crawler excavator (Figure 2)

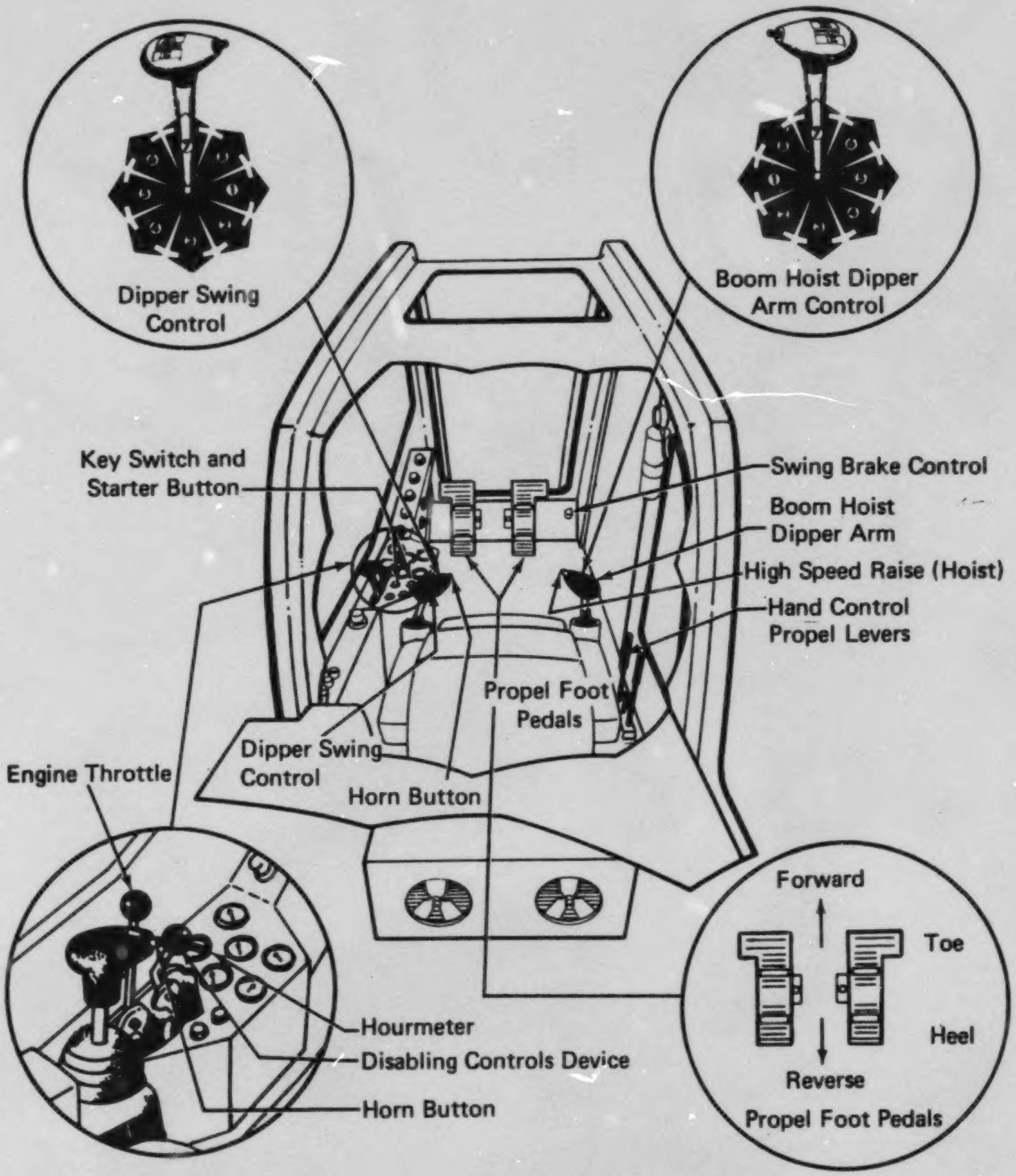
FIGURE 2


Machinery Cab
Operator's Cab
Dipper Arm Cylinder
Boom Hoist Cylinder
Boom
Counterweight
Track
Side Frame
Dipper (Wrist) Cylinder
Dipper Arm
Propel Gear Cases
Lower Rollers
Drive Sprocket
Bucket (Dipper)
Lift or Hoist Hook

INFORMATION SHEET

IV. Controls on a hydraulic crawler excavator (Figure 3; Assignment Sheet #1)

FIGURE 3


Dipper Swing Control
Boom Hoist Dipper Arm Control
Key Switch and Starter Button
Swing Brake Control
Boom Hoist
Dipper Arm
High Speed Raise (Hoist)
Hand Control Propel Levers
Propel Foot Pedals
Dipper Swing Control
Horn Button
Engine Throttle
Hourmeter
Disabling Controls Device
Horn Button
Forward
Toe
Heel
Reverse
Propel Foot Pedals

INFORMATION SHEET

V. Safety precautions related to hydraulic crawler excavators

(NOTE: Excavators are complex and powerful machines that require your complete attention for proper control during operation.)

A. Always wear required protective items

B. Never operate equipment without protective guards in place

C. Use grab irons and steps when mounting or dismounting

D. Keep top edges of ditch clean to avoid anything falling into ditch

E. Never swing or position attachment or load over ground crew or truck cab

F. Never allow anyone to ride on excavator, boom, attachment, or load

G. Take necessary precautions before operating in vicinity of buried utilities

H. Comply with all local, state, and federal regulations when working in vicinity of power lines

I. Never exceed lifting capacity of machine

J. Never undercut machine without adequate shoring

K. Never exceed manufacturer's recommended bucket size

L. Never travel machine in congested area or around people without a signal person

M. Never travel or swing without first making certain no one will be endangered

N. Never get on or off excavator when it is moving

O. Always carry bucket low when traveling

P. Never park on an incline without proper blocking

Q. Always lower attachment to ground before making repairs or servicing

R. Do not refuel with engine running

(NOTE: Knowledge of these safety precautions will help build good judgment in all situations.)

INFORMATION SHEET

VI. Suggestions for effective hydraulic crawler excavator operations

A. Keep equipment clean

B. Service equipment regularly

C. Keep dipper teeth sharp

D. Load dipper quickly and easily with thin slices

E. Take even cuts and heap the dipper

F. Hoist dipper as soon as it is filled

G. When loading trucks, keep busy while waiting; make necessary adjustments, loosen dirt, or clean up corners

H. Make cleanup at final depth to minimize hand labor

I. Set up work cycle so that it will be as short as possible

J. Keep transport distances as short as possible

K. Curl bucket close to dipper arm to reduce spillage

VII. Items to check when servicing a hydraulic crawler excavator

(NOTE: Use manufacturer's service chart and recommendations when servicing equipment.)

A. Visual inspection for broken, worn or missing parts, and leaks

B. Engine oil level, filter, lines, hoses, and breather

C. Air cleaner filter (element)

D. Engine coolant level, radiator cap, hose, and radiator

(CAUTION: Do not remove radiator cap unless engine is cool, then open slowly to release pressure.)

E. Fuel level, fuel filters, and sediment bowl (where applicable)

F. Battery electrolyte level, battery cables, and connectors

(NOTE: Keep sparks and fire away from battery.)

G. Exhaust system

H. Hydraulic fluid level, filters, hose, lines, fittings, and possible leaks

I. Transmission fluid level

J. Transmission pressure line filter and breather

INFORMATION SHEET

K. Brake adjustment and condition

L. Brake master cylinder fluid level

M. Clutch for proper adjustment

N. Drive belts for tension and wear

O. Electrical system (wiring, insulation, and connections)

P. Grease fittings

Q. Tracks

R. All safety devices

S. Windshield wipers (where applicable)

T. Boom and accessories

U. Gauges and controls, for proper functioning

V. Upper structure and components

W. Lower structure and components (track drive chains and pads)

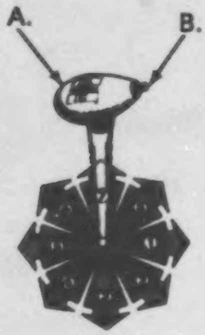
X. Cleanliness of equipment

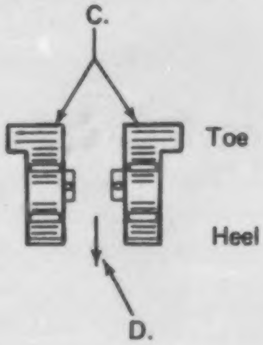
HYDRAULIC CRAWLER EXCAVATORS
UNIT V

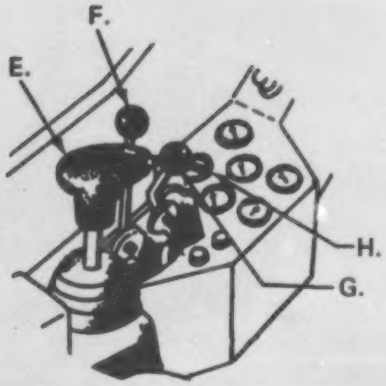
ASSIGNMENT SHEET #1–LABEL CONTROLS ON A HYDRAULIC CRAWLER EXCAVATOR

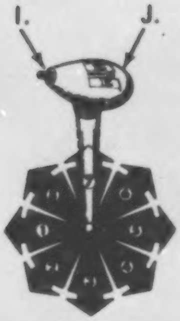
NAME______________________________ SCORE______________

Label the following controls. Write the correct names in the blanks.









A. ______________________

B. ______________________

C. ______________________

D. ______________________

E. ______________________

F. ______________________

G. ______________________

H. ______________________

I. ______________________

J. ______________________

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

ASSIGNMENT SHEET #2–LIST MATERIALS NECESSARY TO SERVICE A HYDRAULIC CRAWLER EXCAVATOR

NAME_______________________________ SCORE_______________

List materials needed to perform service on a hydraulic crawler excavator. Use your Information Sheet and operator's manual for reference.

A. ____

B. ____

C. ____

D. ____

E. ____

F. ____

G. ____

H. ____

I. ____

J. ____

K. ____

L. ____

M. ____

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. Dipper swing control

B. Horn button

C. Propel foot pedals

D. Propel in reverse

E. Dipper swing control

F. Engine throttle

G. Disabling controls device

H. Hourmeter

I. High speed raise (hoist)

J. Boom hoist dipper arm

Assignment Sheet #2

(NOTE: Answers may vary, depending on the manufacturer of the equipment being serviced. The following are suggested answers.)

A. Tool kit and new parts that may be necessary

B. Engine oil

C. Engine coolant

D. Fuel

E. Hydraulic fluid

F. Battery electrolyte or water

G. Transmission fluid

H. Lubricating grease

I. Cleaning solvent

J. Brake fluid

K. Grease gun

L. Pouring spout

M. Shop rags

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

JOB SHEET #1--START, WARM UP, CHECK GAUGES, AND CHECK CONTROLS FOR PERFORMANCE; MAKE FINAL VISUAL INSPECTION AND SHUT DOWN MACHINE

I. Equipment

  A. Hydraulic crawler excavator

  B. Bucket

II. Procedure

  A. Place all controls in neutral

  B. Set brake

  C. Place engine throttle control lever in low idle position

  D. Turn key switch to "on" position

  E. Pull up on depressurizer knob to pressurize hydraulic reservoir

  F. Start engine

  (NOTE: Do not crank engine for more than 20 to 30 seconds at a time; allow 2 minutes before trying again.)

  G. Place engine throttle control lever in half throttle to allow engine to warm up

  H. Check all gauges for proper functioning

  I. Manipulate controls to move forward, turn, and back up

  J. Manipulate boom controls to raise, swing, and lower boom

  K. Manipulate dipper arm control to move arm up and down

  L. Manipulate dipper (wrist) cylinder control to curl bucket

  M. Place all controls in neutral

  N. Dismount machine, using steps and grab irons

  O. Make final visual inspection for leaks, unusual noises, and unusual vibrations

  P. Mount machine, using steps and grab irons

  Q. Make sure bucket is lowered to ground

JOB SHEET #1

R. Let engine idle for approximately four minutes

(NOTE: This will allow it to cool off gradually.)

S. Push engine throttle full forward

T. Push and hold engine stop button until engine stops

U. Turn engine off

V. Dismount machine, using grab irons and steps

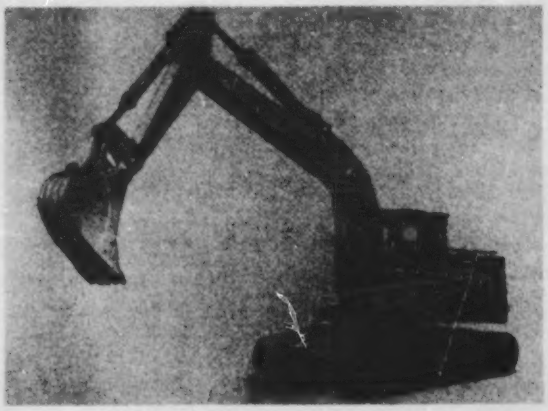
HYDRAULIC CRAWLER EXCAVATORS
UNIT V

JOB SHEET #2–SERVICE A HYDRAULIC CRAWLER EXCAVATOR

I. Equipment and materials

A. Excavator (Figure 4)

FIGURE 4



Courtesy of Caterpillar Tractor Company

B. Manufacturer's operator's guide and service manual

C. Tool kit and spare parts

D. Engine oil

E. Cleaning solvent

F. Engine coolant and/or water

G. Fuel

H. Hydraulic fluid

I. Battery electrolyte

J. Transmission fluid

K. Lubricating grease

L. Air supply

M. Shop rags

N. Grease gun

O. Pouring spout

JOB SHEET #2

II. Procedure

(NOTE: Follow manufacturer's specifications and recommendations when servicing equipment.)

A. Walk around equipment, inspecting for broken, worn, or missing parts or leaks

B. Check engine oil level; fill if necessary

C. Check filter and breather; clean or replace as necessary

D. Check engine coolant level; fill if necessary

E. Check radiator pressure cap and hoses; replace if necessary

(CAUTION: Do not remove radiator cap unless engine is cool; then open slowly to release pressure.)

F. Check fuel level; fill if necessary

G. Check fuel filters and sediment bowl (where applicable); clean or replace as necessary

H. Check hydraulic fluid; fill if necessary

I. Check hydraulic reservoir filter and swing filter, clean or replace as necessary

J. Check battery electrolyte level; fill if necessary

K. Check battery cleanliness and all connections; clean if necessary

L. Check transmission fluid level; fill if necessary

M. Check air filter element; clean or replace as necessary

N. Visually check electrical system

O. Check exhaust system for any defects

P. Check drive belts for tension and wear; adjust or replace as necessary

Q. Clean all grease fittings and lubricate

R. Check all safety devices for proper operation

S. Check gauges and controls for proper operation; lubricate as necessary

T. Clean equipment

JOB SHEET #2

U. Check boom and attachments

V. Check lower structure and components (tracks, drive chains, and pads)

W. Check upper structure and components

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

JOB SHEET #3--DIG A STRAIGHT-LINE DITCH, AND LOAD A HAUL TRUCK

I. Equipment

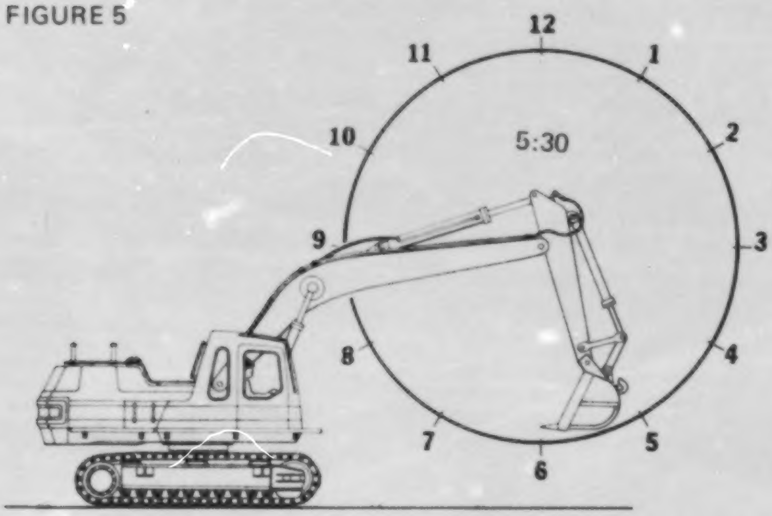
A. Excavator

B. Excavation bucket

II. Procedure

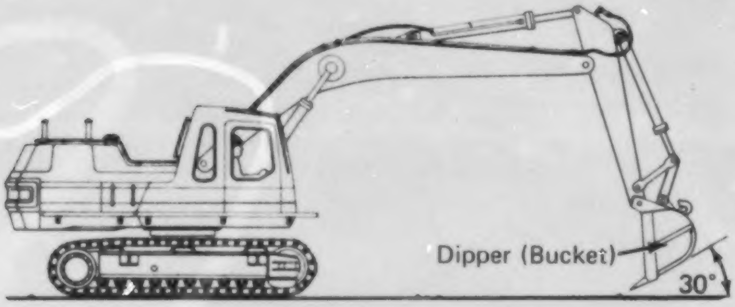
A. Engage dipper arm control to move dipper to 5:30 (Figure 5)

FIGURE 5


12
1
2
3
4
5
6
7
8
9
10
11
5:30

B. Engage dipper control to position dipper (bucket) cutting edge at a 30° angle (Figure 6)

FIGURE 6


Dipper (Bucket)
30°

JOB SHEET #3

C. Move boom control forward to lower dipper to ground

D. Pull dipper arm control in, and as dipper enters the material, manipulate the dipper (wrist) cylinder control so that cutting edge is working parallel to ground

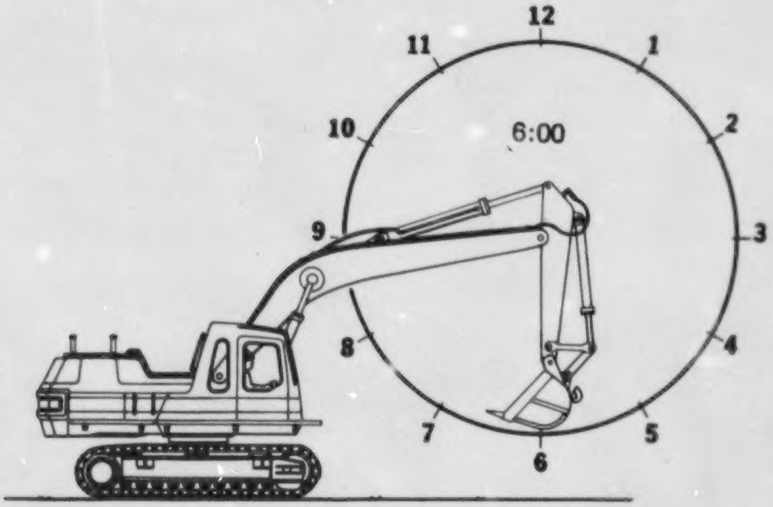
E. Raise or lower boom control slightly if dipper arm slows or completely stops filling the dipper

F. Pick up bucket when it is full

G. Raise boom control to clear the cut and side of truck, then swing machine to truck

(NOTE: Keep dipper arm at 6:00. See Figure 7.)

FIGURE 7



H. Actuate both the dipper (wrist) and dipper arm control levers at the same time for a fast, controlled dump

I. Return to cut and continue cycle until ditch is complete or truck is loaded

(NOTE: As proper depth of ditch is reached, move backhoe, keeping in line with marked ditch line.)

J. Use time while truck is gone to clean up corners and crumbs and to reposition excavator

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

JOB SHEET #4--LOAD A HYDRAULIC CRAWLER EXCAVATOR FOR TRAVEL

I. Equipment

  A. Excavator

  B. Trailer (low boy)

  C. Blocks

  D. Chains

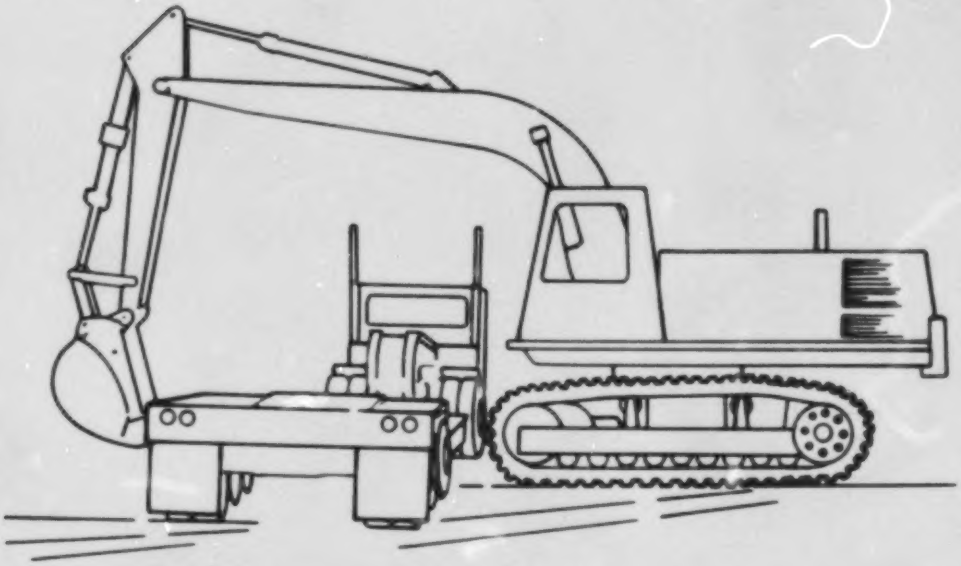
II. Procedure

  A. Block wheels of trailer

  B. Position excavator so that it faces side of trailer

  C. Position boom over opposite side of trailer (Figure 8)

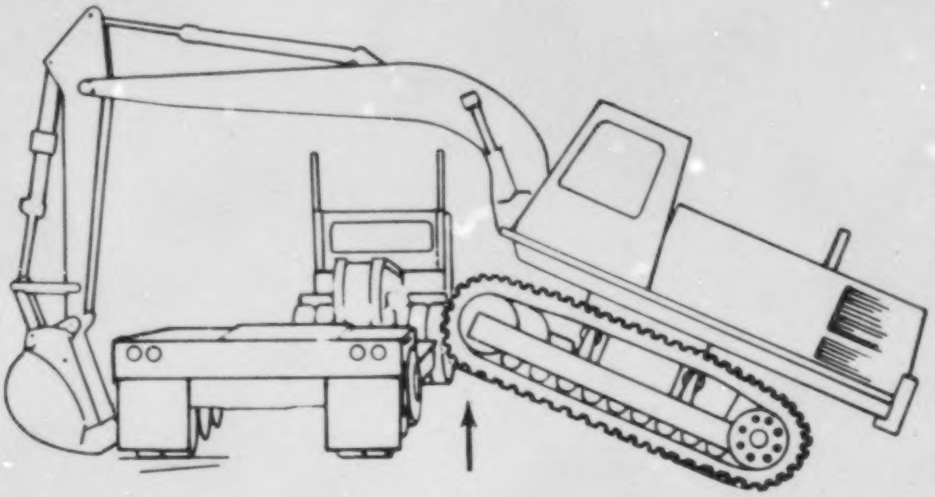
FIGURE 8



JOB SHEET #4

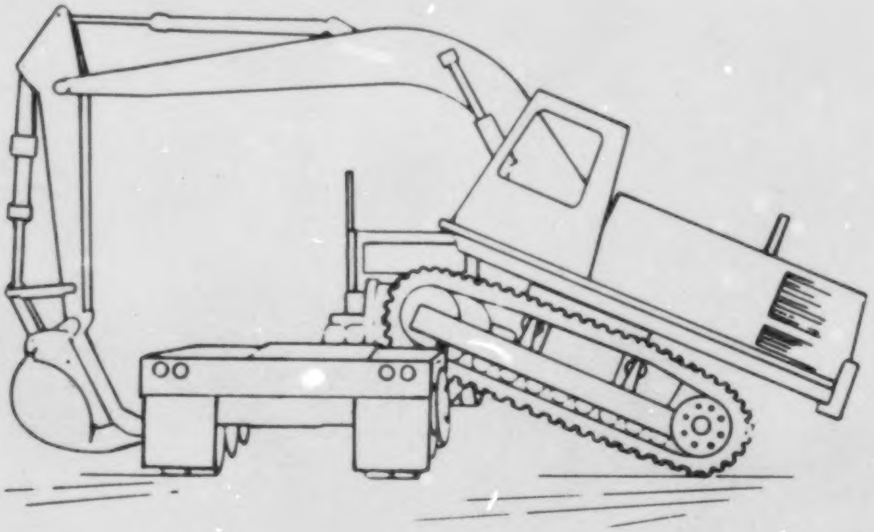
D. Place bucket on the ground and apply down pressure on boom to raise tracks clear of trailer bed (Figure 9)

FIGURE 9



E. Drive forward onto side of trailer bed (Figure 10)

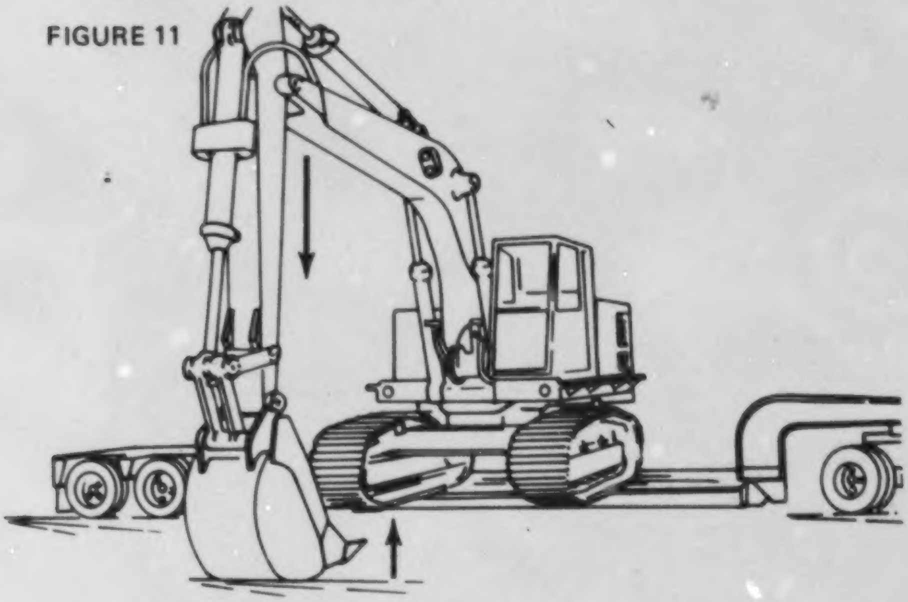
FIGURE 10



JOB SHEET #4

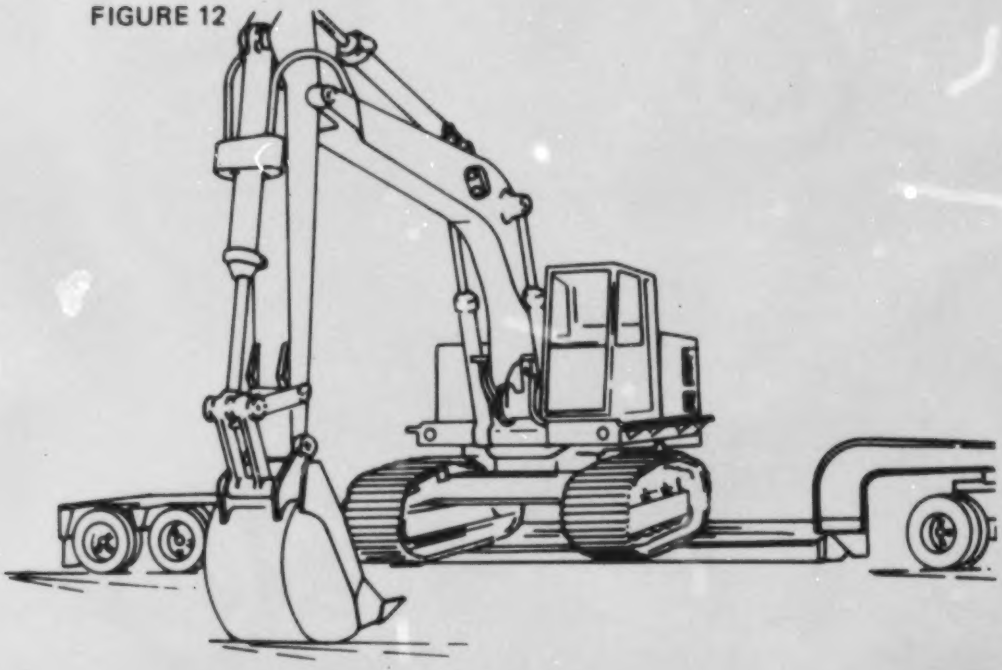
F. Raise boom, swing upper structure 180°, then apply down pressure on boom to raise back of tracks (Figure 11)

FIGURE 11



G. Drive forward until excavator is on trailer (Figure 12)

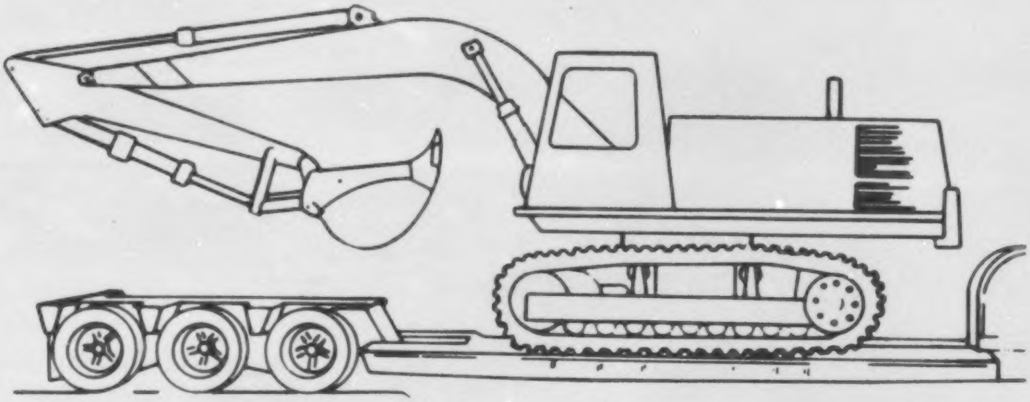
FIGURE 12



JOB SHEET #4

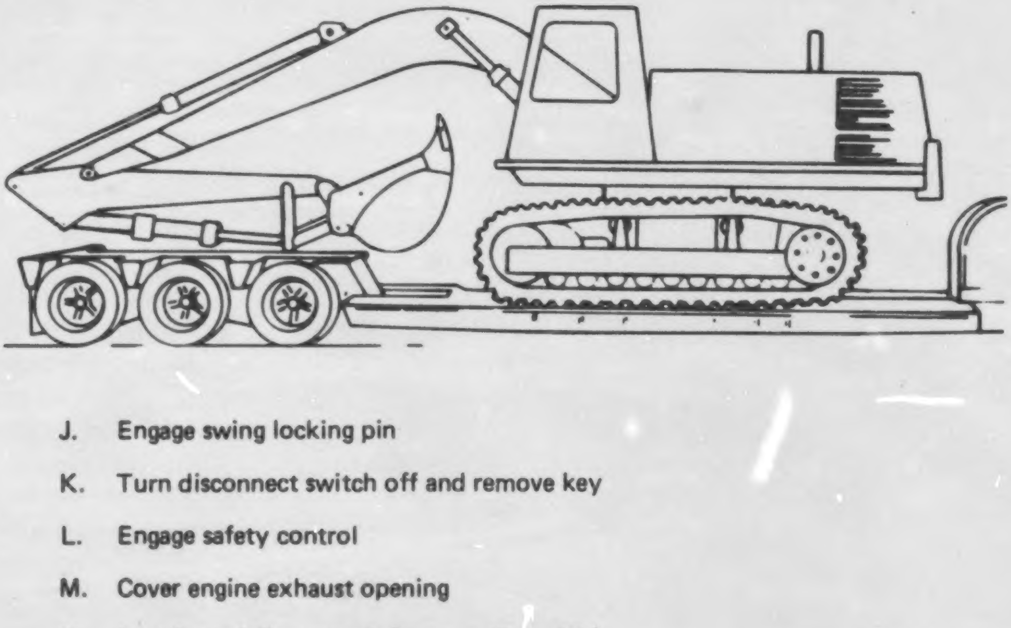
H. Raise boom, then turn tracks so that excavator faces rear of trailer (Figure 13)

FIGURE 13



I. Position excavator in center of trailer in shipping position (Figure 14)

FIGURE 14



J. Engage swing locking pin

K. Turn disconnect switch off and remove key

L. Engage safety control

M. Cover engine exhaust opening

N. Install vandalism guards (not on all models)

O. Install tie downs at several locations

P. Observe all safety regulations

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

JOB SHEET #5--OPERATE EXCAVATOR TO SET PIPE

I. Equipment and materials

- A. Excavator
- B. Pipe hook or sling with sliding choker hook

  (NOTE: Some operators would rather use a sling than a pipe hook, especially when working in a trench box.)

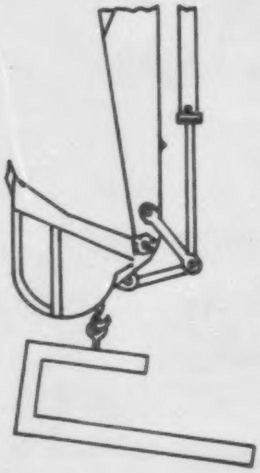
- C. Subgrade material

II. Procedure

(NOTE: After excavation of ditch, it will be necessary to place subgrade material in bottom of ditch.)

- A. Fill bucket with subgrade material
- B. Cast out bucket to spread material
- C. Drag bucket (teeth down) through ditch to help level out material
- D. Curl bucket so that hook on bucket is in position to attach pipe hook or sling
- E. Connect pipe hook to bucket (Figure 15)

FIGURE 15

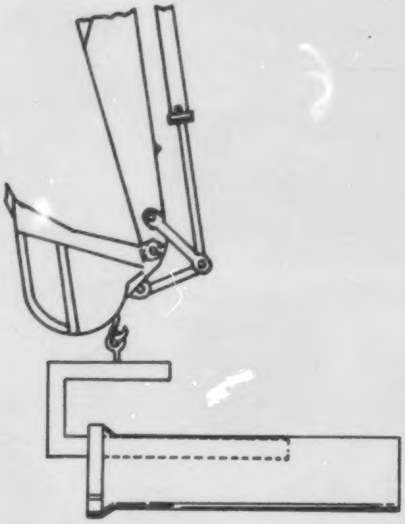


JOB SHEET #5

F. Manipulate controls to slide pipe hook into pipe (Figure 16)

(CAUTION: To prevent accidents and injury, be sure proper size pipe hook is used.)

FIGURE 16



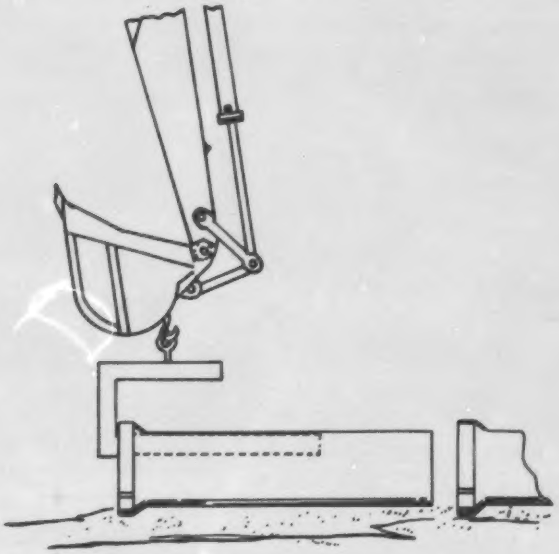
G. Raise boom cautiously until pipe hook contacts pipe

H. Raise pipe until it is clear of all obstructions

(CAUTION: When working around power lines, maintain a safe distance at all times.)

I. Lower pipe so that it will lay to the end of pipe already set (Figure 17)

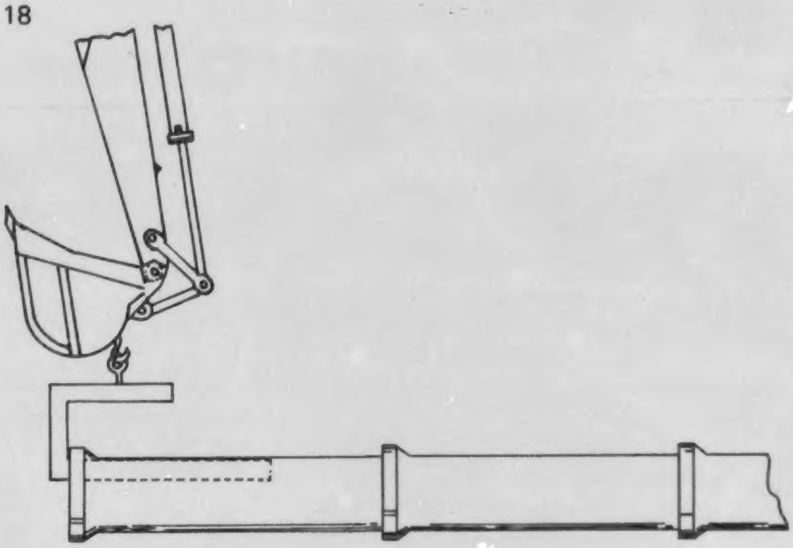
FIGURE 17



JOB SHEET #5

J. Move bucket control to roll bucket out and move pipe in place (Figure 18)

FIGURE 18



K. Lower boom slightly and slide pipe hook out of pipe

L. Reposition excavator to set next pipe

M. Continue cycle until job is complete

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

JOB SHEET #6–OPERATE EXCAVATOR IN UNSTABLE SOIL, USING MATS

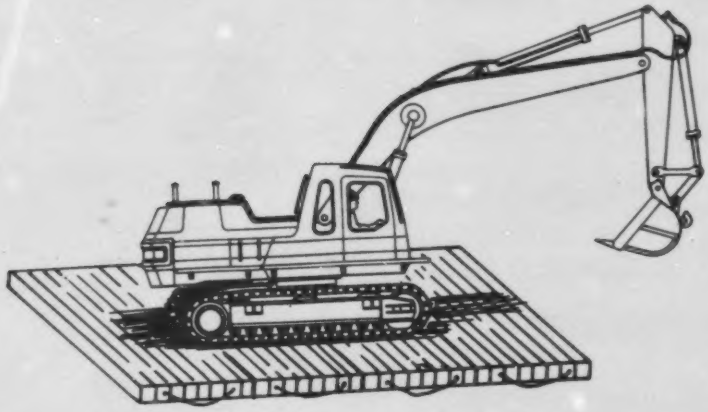
I. Equipment

   A. Excavator (Figure 19)

   B. Five mats

   C. Sling

FIGURE 19



II. Procedure

   A. Determine exactly where mats should be placed

   B. Position excavator

   C. Swing boom over mats and lower

   (NOTE: At this point, a sling will be attached from hoist hook on excavator to end of mat.)

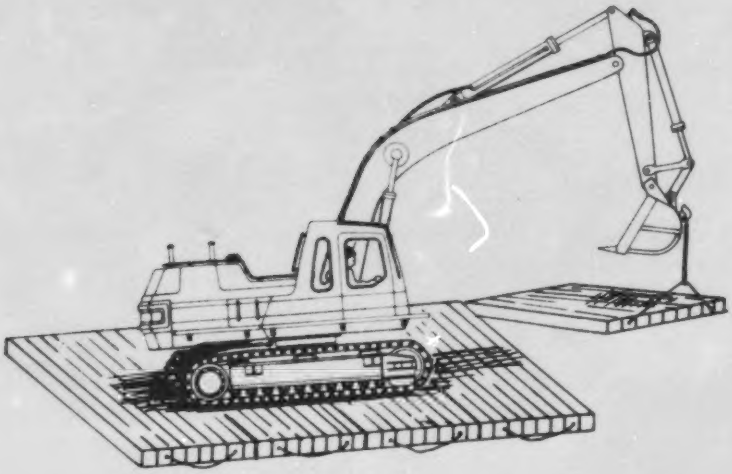
   D. Raise boom until mat is clear of the haul unit

   E. Swing excavator into position for setting first mat

JOB SHEET #6

F. Lower boom until end of mat is in correct position (Figure 20)

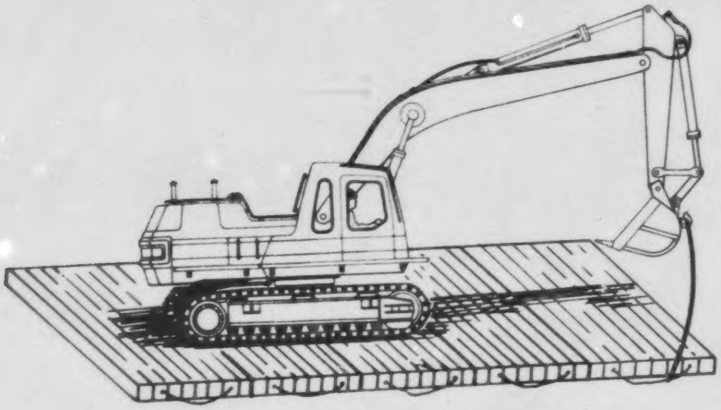
FIGURE 20



G. Continue lowering boom until mat is flat on the ground

H. Continue lowering boom until there is enough slack to remove sling from mat (Figure 21)

FIGURE 21



JOB SHEET #6

I. Raise boom and swing back to haul unit to pick up second mat

J. Repeat the lifting and swinging procedures until all five mats are in place

K. Position excavator so that tracks will engage mats evenly

L. Engage travel clutch and cautiously walk excavator forward onto the mats

M. Travel forward until front of tracks are on the last mat laid

N. Disengage travel clutch to stop forward motion

O. Swing excavator until boom is over end of last mat (first one set); lower boom until sling can be connected to the mat

P. Raise boom until mat is high enough to clear ground and other obstructions

Q. Swing excavator around and lower boom so that end of mat is resting on the ground

R. Engage swing clutch gradually and as excavator starts to swing, lower the boom so that the mat will be laid down in the line with the other mats

(NOTE: If the swing is faster than the lowering of the boom, the mat will be pulled away from the correct position and will have to be raised again and reset.)

S. Repeat the procedures of traveling forward on the mats and moving the mats forward until the crane is in the proper position to start excavating

(NOTE: At this time, the mats must be positioned to allow a series of forward and backward movements. During course of travel, if it becomes necessary to make turns, the mats can be laid at a slight angle. If mud is allowed on the mats, causing slippage during turns, a few bolts may be installed through the holes in the track pads for better traction.)

T. Repeat procedures of traveling, moving mats, and digging until project is complete

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

JOB SHEET #7--OPERATE EXCAVATOR, USING TRENCH BOX

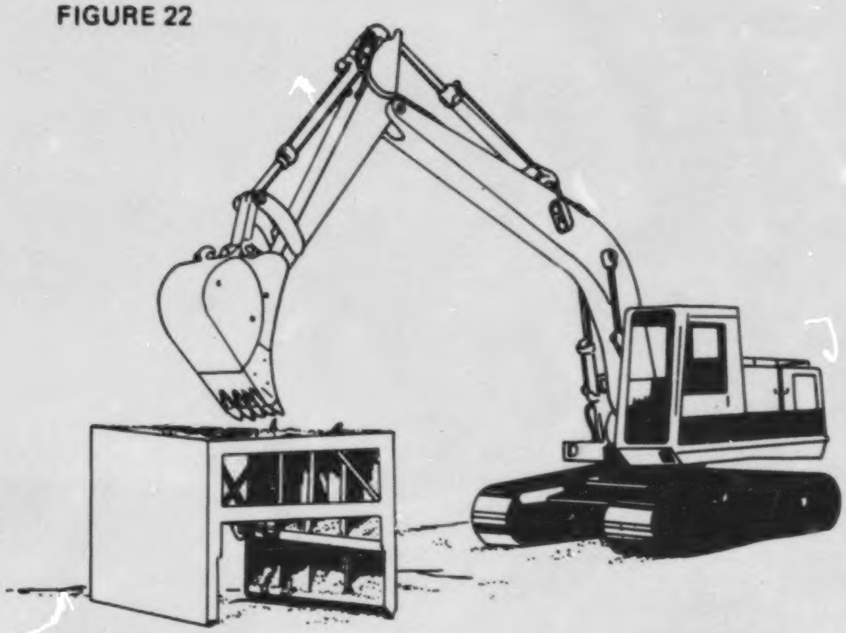
(NOTE: A trench box may be used when working in deep ditches and while working in unstable soils.)

I. Equipment and materials

   A. Excavator (Figure 22)

   B. Trench box

FIGURE 22



II. Procedure

   A. Position excavator to pick up trench box

   B. Connect sling from trench box to hook on back of bucket

   C. Lift trench box until it is clear of all obstacles

JOB SHEET #7

D. Swing trench box over ditch location, then lower to proper location

(NOTE: The trench box is used as a safety device to protect workers while performing operations in a ditch. This excavator usually works along with another piece of equipment, which supplies materials to the workers and in some cases does the backfilling.)

E. Slide trench box slowly along bottom of ditch as work progresses

F. Continue backing excavator and pulling trench box through the ditch until job is completed or until trench box is no longer needed

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

TEST

NAME ______________________ SCORE ____________

1. List uses of hydraulic crawler excavators.

   a. ______________________
   b. ______________________
   c. ______________________
   d. ______________________
   e. ______________________
   f. ______________________
   g. ______________________
   h. ______________________

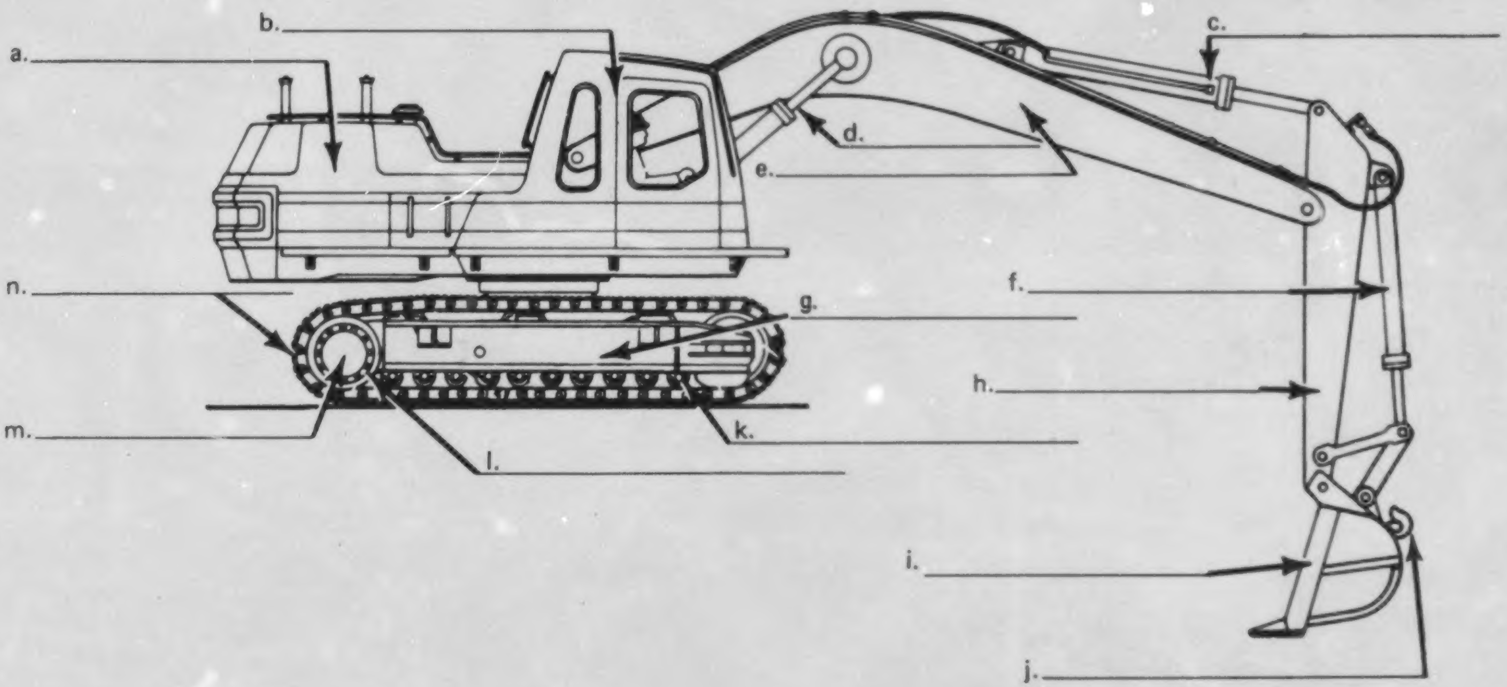
2. Match terms associated with hydraulic crawler excavators to their correct definitions. Write the correct numbers in the blanks.

   _____a. Destruction or scrapping
   _____b. To tilt
   _____c. Complete set of operations performed before repeating them
   _____d. Dead or nonworking load attached to one end or side of a machine to help improve balance

   1. Counterweight
   2. Work cycle
   3. Curl
   4. Demolition

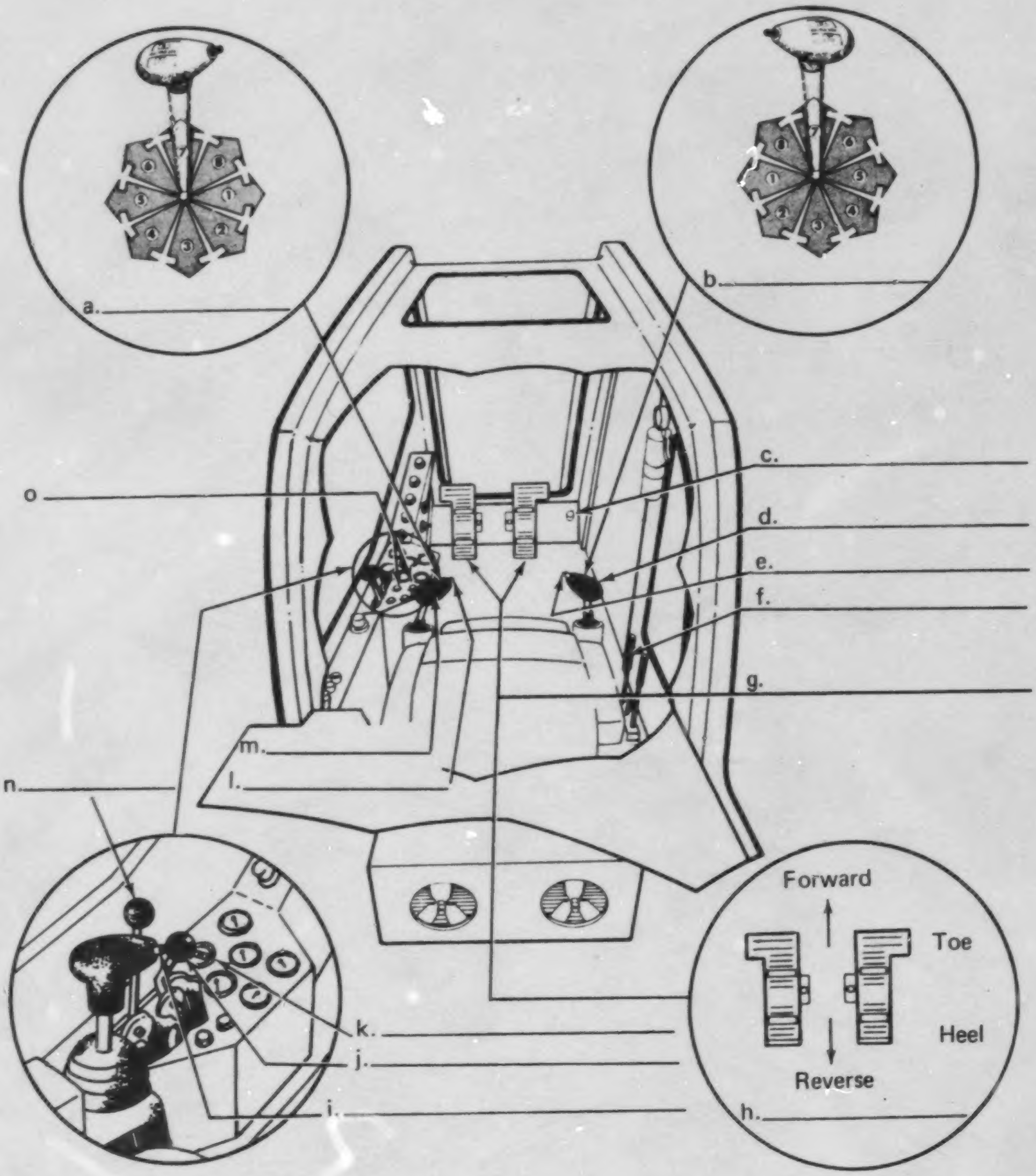
TEST

3. Label basic components of a hydraulic crawler excavator. Write the correct names in the blanks.


a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.
m.
n.

TEST

4. Label controls on a hydraulic crawler excavator. Write the correct names in the blanks. Some answers may be used more than once.


a.
b.
c.
o
d.
e.
f.
g.
m.
l.
n.
Forward
Toe
Heel
Reverse
k.
j.
i.
h.

TEST

5. State twelve safety precautions related to hydraulic crawler excavators.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

i. ____________________

j. ____________________

k. ____________________

l. ____________________

6. State eight suggestions for effective hydraulic crawler excavator operations.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

7. Select from the following list items to check when servicing a hydraulic crawler excavator. Write an "X" in the blank before each correct answer.

_____a. Battery plates

_____b. Engine oil level, filter, lines, hoses, and breather

_____c. Transmission fluid level

TEST

______d. Cooling system shutters

______e. Electrical system (wiring, insulation, and connections)

______f. Lower structure and components (track drive chains and pads)

______g. Hook block and cables

______h. Drive belts for tension and wear

______i. Gauges and controls, for proper functioning

______j. Air cleaner filter (element)

______k. Grease fittings

______l. Tire pressure

______m. All safety devices

______n. Fuel level, fuel filters, and sediment bowl (where applicable)

______o. Battery electrolyte level, battery cables, and connectors

(NOTE: Test question 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Start, warm up, check gauges, and check controls for performance; make final visual inspection and shut down machine.

   b. Service a hydraulic crawler excavator.

   c. Dig a straight-line ditch, and load a haul truck.

   d. Load a hydraulic crawler excavator for travel.

   e. Operate excavator to set pipe.

   f. Operate excavator in unstable soil, using mats.

   g. Operate excavator, using trench box.

HYDRAULIC CRAWLER EXCAVATORS
UNIT V

ANSWERS TO TEST

1. a. Ditching
   b. Excavating basements and sunken pits
   c. Mud excavation
   d. Hoisting
   e. Demolition
   f. Logging
   g. Scrap handling
   h. Install shoring
2. a. 4
   b. 3
   c. 2
   d. 1
3. a. Machinery cab
   b. Operator's cab
   c. Dipper arm cylinder
   d. Boom hoist cylinder
   e. Boom
   f. Dipper (wrist) cylinder
   g. Side frame
   h. Dipper arm
   i. Bucket (dipper)
   j. Lift or hoist hook
   k. Lower rollers
   l. Drive sprocket
   m. Propel gear cases
   n. Track

ANSWERS TO TEST

4. a. Dipper swing control
   b. Boom hoist dipper arm control
   c. Swing brake control
   d. Boom hoist dipper arm
   e. High speed raise (hoist)
   f. Hand control propel levers
   g. Propel foot pedals
   h. Propel foot pedals
   i. Horn button
   j. Disabling controls device
   k. Hourmeter
   l. Horn button
   m. Dipper swing control
   n. Engine throttle
   o. Key switch and starter button
5. Answer should include any twelve of the following
   a. Always wear required protective items
   b. Never operate equipment without protective guards in place
   c. Use grab irons and steps when mounting or dismounting
   d. Keep top edges of ditch clean to avoid anything falling into ditch
   e. Never swing or position attachment or load over ground crew or truck cab
   f. Never allow anyone to ride on excavator, boom, attachment, or load
   g. Take necessary precautions before operating in vicinity of buried utilities
   h. Comply with all local, state, and federal regulations when working in vicinity of power lines
   i. Never exceed lifting capacity of machine
   j. Never undercut machine without adequate shoring

ANSWERS TO TEST

   k. Never exceed manufacturer's recommended bucket size
   l. Never travel machine in congested area or around people without a signal person
   m. Never travel or swing without first making certain no one will be endangered
   n. Never get on or off excavator when it is moving
   o. Always carry bucket low when traveling
   p. Never park on an incline without proper blocking
   q. Always lower attachment to ground before making repairs or servicing
   r. Do not refuel with engine running

6. Answer should include any eight of the following
   a. Keep equipment clean
   b. Service equipment regularly
   c. Keep dipper teeth sharp
   d. Load dipper quickly and easily with thin slices
   e. Take even cuts and heap the dipper
   f. Hoist dipper as soon as it is filled
   g. When loading trucks, keep busy while waiting; make necessary adjustments, loosen dirt, or clean up corners
   h. Make cleanup at final depth to minimize hand labor
   i. Set up work cycle so that it will be as short as possible
   j. Keep transport distances as short as possible
   k. Curl bucket close to dipper arm to reduce spillage
7. b, c, e, f, h, i, j, k, m, n, o
8. Performance skills evaluated to the satisfaction of the instructor

PUMPS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of pumps and be able to service and operate a pump. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of pumps.
2. Match terms associated with pumps to their correct definitions.
3. List general classifications of pumps.
4. List power sources for pumps.
5. Distinguish between standard pump ratings in general use.
6. Label parts of a centrifugal pump.
7. Identify types of pumps.
8. State suggestions for effective pump operation.
9. Demonstrate the ability to
    a. Service a pump.
    b. Start and prime a pump.

PUMPS
UNIT I

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Obtain and use materials for reference, motivation, and complete study of the equipment.

   G. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Service a Pump

      2. Job Sheet #2--Start and Prime a Pump

   E. Test

   F. Answers to test

III. Unit references

   A. *Composite Condensed Catalog 7-CC-11*. Mansfield, Ohio: The Gorman-Rupp Company, 1967.

   B. Nichols, Herbert L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

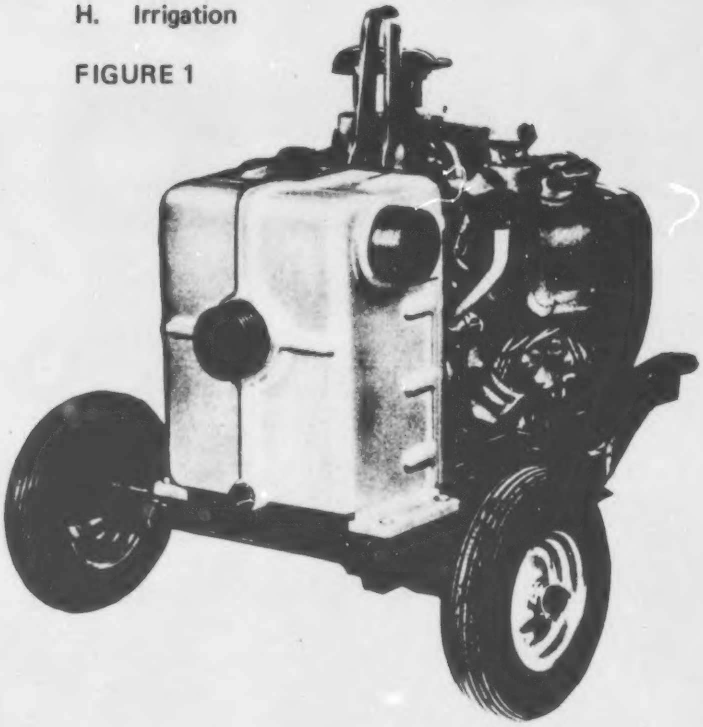
PUMPS
UNIT I

INFORMATION SHEET

I. Uses of pumps (Figure 1)

- A. Dewatering
- B. Bridgework
- C. Jet piling
- D. Excavation pumping
- E. General transfer
- F. Waste handling
- G. Fire fighting
- H. Irrigation

FIGURE 1



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INFORMATION SHEET

II. Terms and definitions

- A. Pumps--Mechanical devices that convey liquids against force of gravity
- B. Centrifugal--Moving in a direction away from the center of an axis
- C. Reciprocating--Alternating back-and-forth motion of pistons
- D. Diaphragm--Thin, flexible material fastened securely around perimeter with center moved back and forth to provide displacing action
- E. Rotary--Turning on an axis

  EXAMPLES: Impellar, gear
- F. Axis--Spindle or center of any rotating motion
- G. Prime--To provide means to start a process, as in supplying enough water to a pump to allow it to start pumping
- H. Turbine--Rotary engine driven by pressure of liquid or gas against its vanes
- I. Helical--Spiral
- J. LPG--Liquid petroleum gas
- K. Caisson pump--Heavy-duty submersible pump that may be suspended into a hole or casing
- L. Four-stage--Number of impellers used in a pump to increase pressure
- M. Impellers--Rotating members of a pump that use centrifugal force to discharge fluid
- N. Jetting--Process of drilling using water under high pressure; used for sinking piles and/or pumping water along sides of piling to displace the soil, relieve friction, and gain better penetration
- O. Piling--Support beams, slabs, or columns of wood, steel, or concrete placed in the soil for transmitting a load through water or a stratum of poor bearing capacity to a stratum of adequate bearing capacity
- P. Trash pump--Mechanical device used for pumping industrial waste

III. General classifications of pumps

- A. Centrifugal
- B. Reciprocating

INFORMATION SHEET

- C. Diaphragm
- D. Propeller
- E. Turbine
- F. Rotary
- G. Helical

(NOTE: Pumps most commonly used for construction work are centrifugal and diaphragm pumps.)

IV. Power sources for pumps

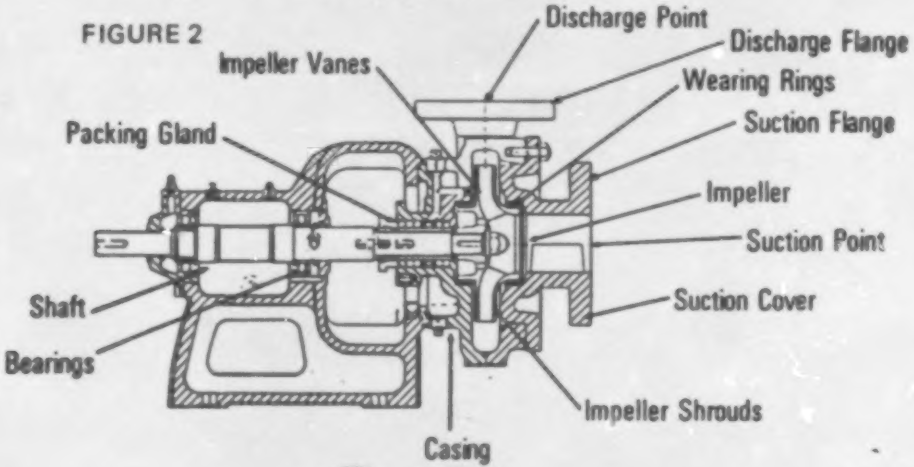
- A. Gasoline engine
- B. Diesel engine
- C. Air
- D. Steam
- E. Electricity (AC and DC)
- F. LPG engine

V. Standard pump ratings in general use

- A. GPM (gallons per minute)--Volume of liquid delivered by pump
- B. psi (pounds per square inch)--Pressure at which liquid is moved

VI. Parts of a centrifugal pump (Figure 2)

FIGURE 2

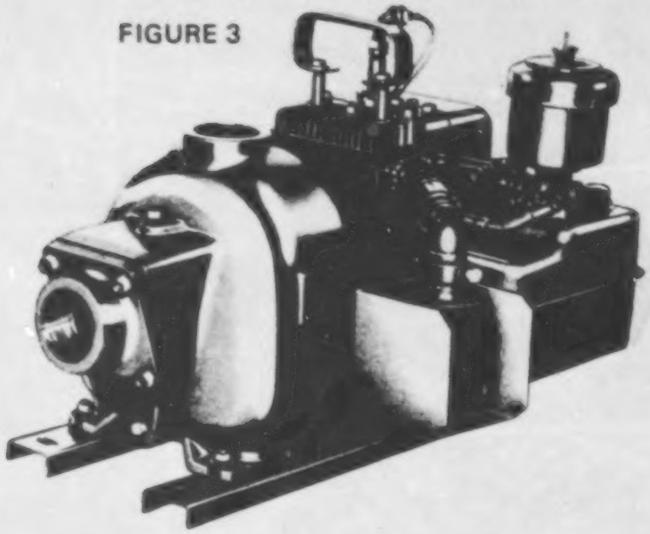

Discharge Point
Discharge Flange
Impeller Vanes
Wearing Rings
Packing Gland
Suction Flange
Impeller
Suction Point
Shaft
Suction Cover
Bearings
Impeller Shrouds
Casing

INFORMATION SHEET

VII. Types of pumps (Figures 3-11)

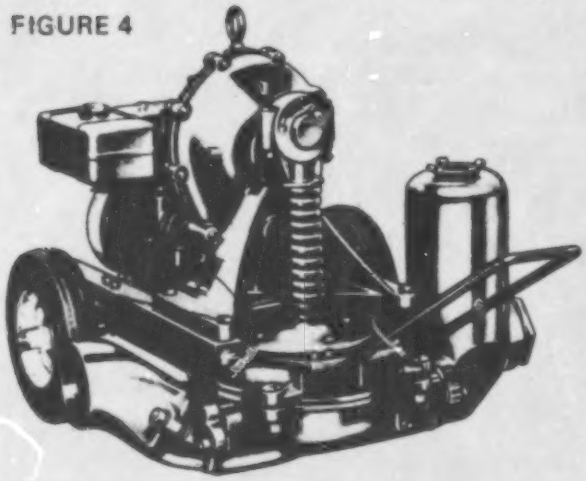
A. Portable centrifugal petroleum pump

FIGURE 3



B. Portable gasoline-engine-driven diaphragm pump

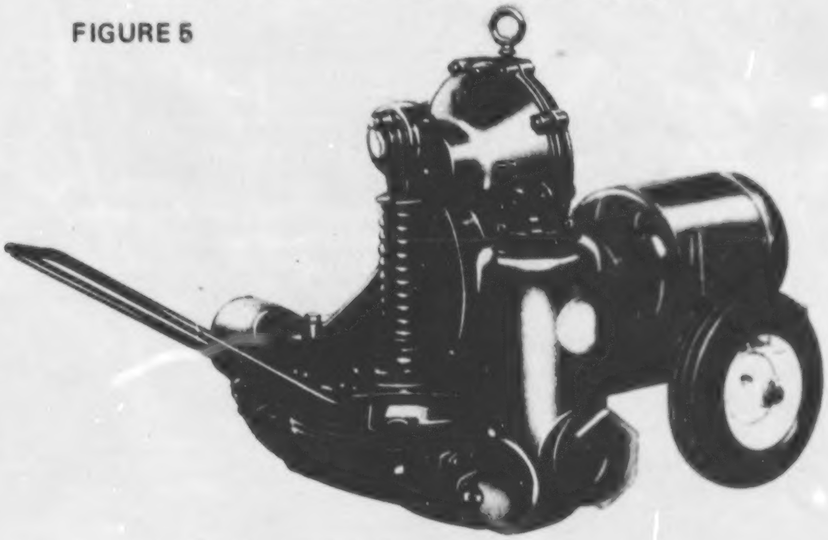
FIGURE 4



INFORMATION SHEET

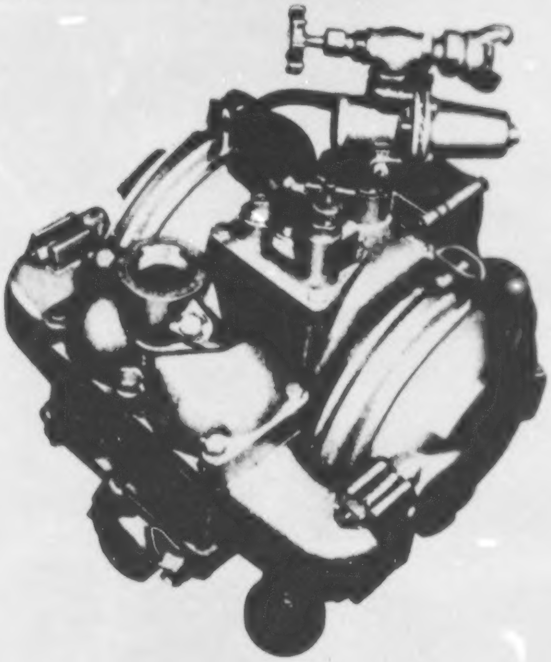
C. Portable electric-motor-driven diaphragm pump

FIGURE 5



D. Portable air-powered diaphragm pump

FIGURE 6

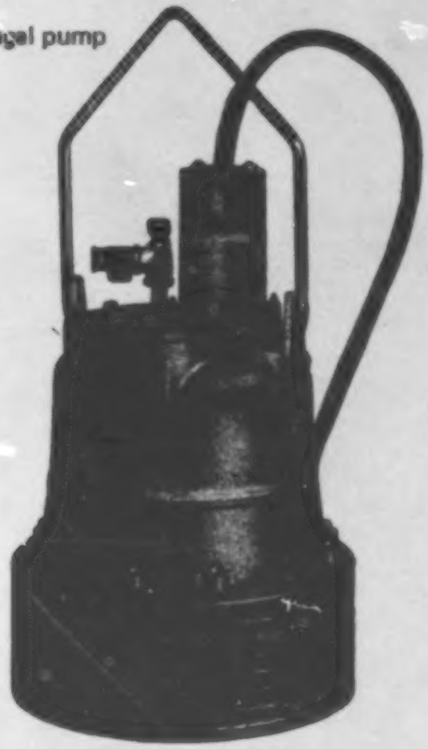


Courtesy of the Warren Rupp Company.

INFORMATION SHEET

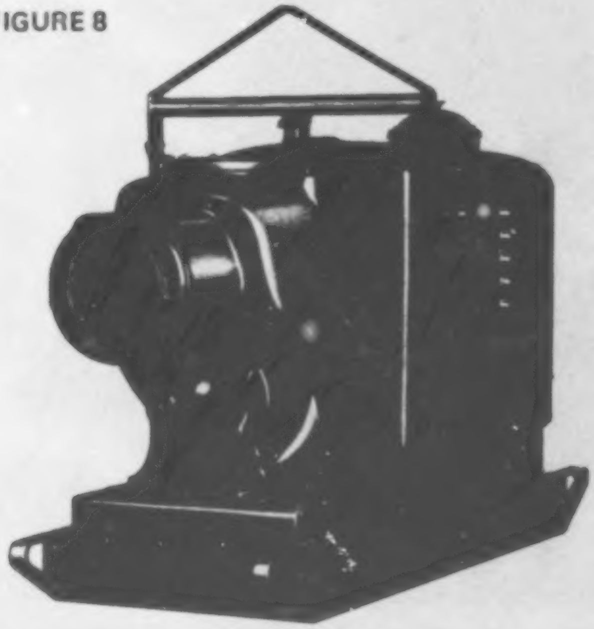
E. Submersible centrifugal pump

FIGURE 7



F. Skid-mounted, self-priming centrifugal pump

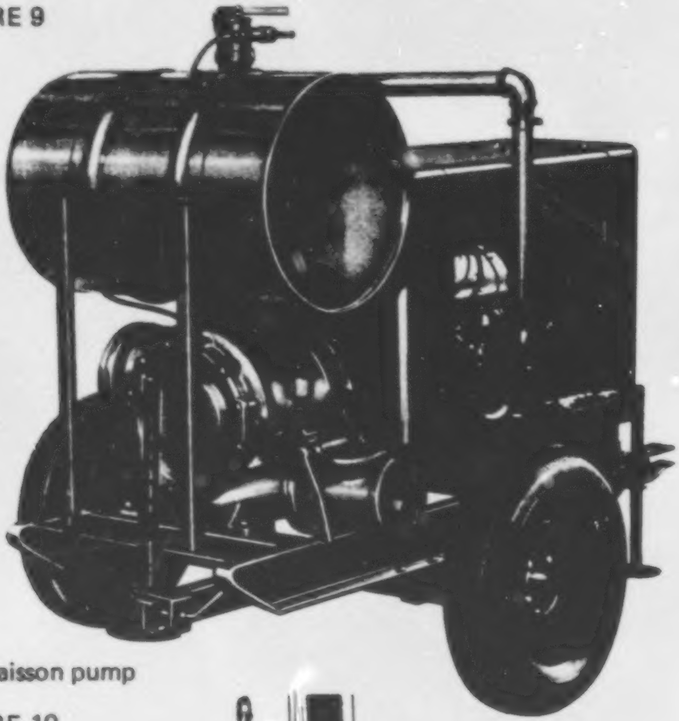
FIGURE 8



INFORMATION SHEET

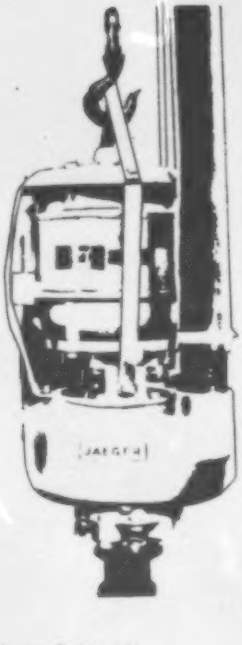
G. Trailer-mounted, high-pressure centrifugal pump

FIGURE 9



H. Caisson pump

FIGURE 10

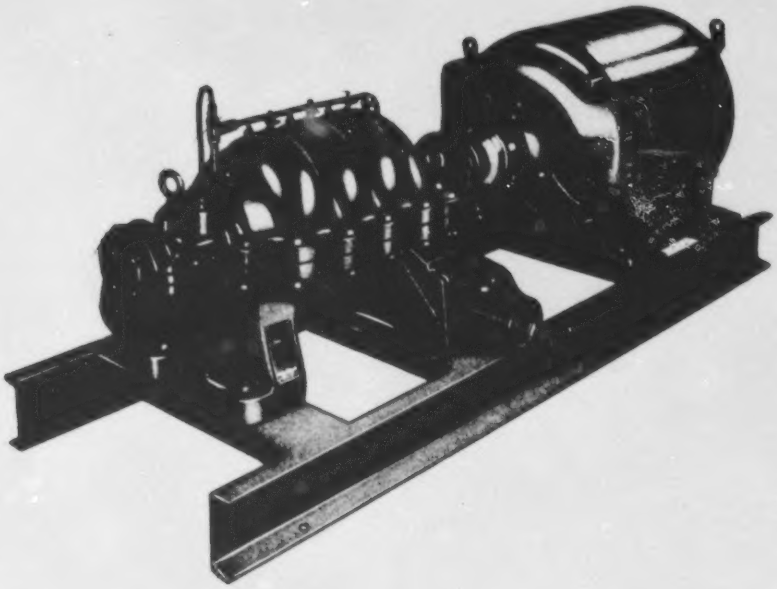


Used with permission of Jaeger Sykes, Inc.

INFORMATION SHEET

I. Four-stage, high-pressure centrifugal jetting pump

FIGURE 11



VIII. Suggestions for effective pump operation

A. Avoid sharp turns or abrupt changes in pipe or hose size

(NOTE: Use 30° or 45° elbows and taper fittings.)

B. Avoid air leaks in the inlet line

C. Keep inlet strainer free of debris

D. Install a foot valve above strainer on inlet to prevent hose from draining when pump is shut down

E. Place pump as near the water level as possible since liquids can be pushed much easier than they can be pulled

F. Protect pump and hose against freezing

G. Inspect and service pumps regularly

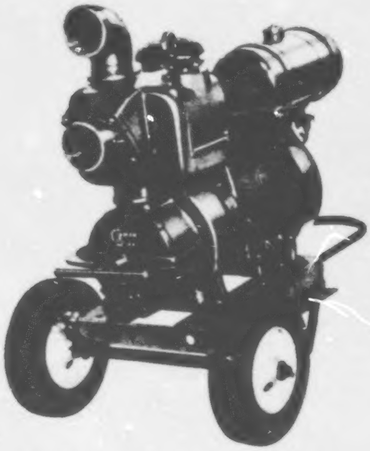
PUMPS
UNIT I

JOB SHEET #1--SERVICE A PUMP

I. Equipment and materials

- A. Portable gasoline-engine-driven pump (Figure 12)
- B. Tool kit and spare parts that may be needed
- C. Manufacturer's service chart
- D. Engine oil
- E. Gasoline
- F. Cleaning solvent
- G. Shop rags

FIGURE 12



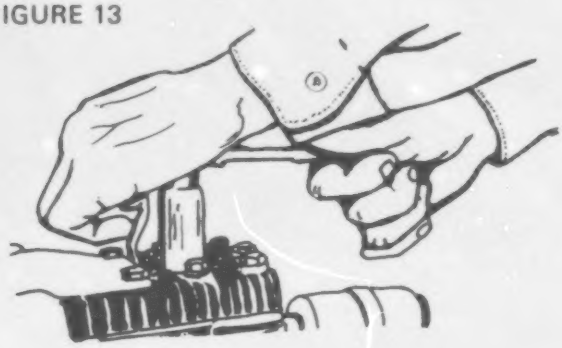
II. Procedure

- A. Make a visual inspection for broken, worn, or missing parts, and leaks
- B. Remove filler cap and check engine oil level; fill if necessary
- C. Check sediment bowl; remove and clean if it is dirty
- D. Check air cleaner filter; clean or replace if necessary
- E. Check breather filter; clean and service if necessary
- F. Check rope starter for proper performance

JOB SHEET #1

G. Remove spark plug (Figure 13)

FIGURE 13

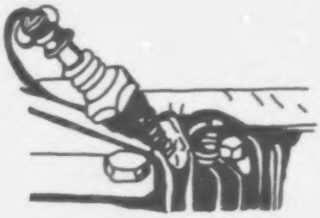


H. Check gap and carbon

I. Clean plug and reset gap

J. Connect plug to spark plug wire and ground plug to engine (Figure 14)

FIGURE 14



K. Crank engine one or two turns

L. Observe spark at the electrode

(NOTE: If there is no spark or if spark is a blue-orange color, replace the plug with a new one.)

M. Replace spark plug

N. Clean engine and pump

O. Remove end plate of pump; check impeller and clean if necessary

P. Replace end plate

Q. Check hoses and inlet strainer

PUMPS
UNIT I

JOB SHEET #2--START AND PRIME A PUMP

I. Equipment and materials

  A. Pump

  B. Water container

II. Procedure

  A. Place pump so that it is as level as possible

  B. Place inlet hose with strainer in water

  C. Make sure fuel valve is on

  D. Turn stop switch to on

  (NOTE: This may be a grounding blade near spark plug. If so, be sure it is not touching the spark plug.)

  E. Close choke valve or prime engine

  F. Adjust throttle to recommended opening for starting

  G. Pull hard on starter rope

  H. Try again if engine fails to start

  (NOTE: If engine fails to start after a few times, open choke valve and try again.)

  I. Allow engine to operate at fast idle for a minute or two after it starts

  J. Open the choke gradually as the engine warms up

  K. Remove primer plug from pump

  L. Fill pump with water

  M. Replace plug when pump starts discharging

PUMPS
UNIT I

TEST

NAME ______________________________ SCORE ____________________

1. List five uses of pumps.

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

2. Match terms associated with pumps to their correct definitions. Write the correct numbers in the blanks.

_____a. Mechanical devices that convey liquids against force of gravity

_____b. Moving in a direction away from the center of an axis

_____c. Alternating back-and-forth motion of pistons

_____d. Thin, flexible material fastened securely around perimeter with center moving back and forth to provide displacing action

_____e. Turning on an axis

_____f. Spindle or center of any rotating motion

_____g. To provide means to start a process, as in supplying enough water to a pump to allow it to start pumping

_____h. Rotary engine driven by pressure of liquid or gas against its vanes

_____i. Spiral

_____j. Liquid petroleum gas

_____k. Heavy-duty submersible pump that may be suspended into a hole or casing

1. Turbine
2. Diaphragm
3. Prime
4. LPG
5. Pumps
6. Rotary
7. Reciprocating
8. Helical
9. Axis
10. Centrifugal
11. Caisson pump

TEST

_____l. Number of impellers used in a pump to increase pressure

_____m. Rotating members of a pump that use centrifugal force to discharge fluid

_____n. Process of drilling using water under high pressure; used for sinking piles and/or pumping water along sides of piling to displace the soil, relieve friction, and gain better penetration

_____o. Support beams, slabs, or columns of wood, steel, or concrete placed in the soil for transmitting a load through water or a stratum of poor bearing capacity to a stratum of adequate bearing capacity

_____p. Mechanical device used for pumping industrial waste

12. Piling
13. Impellers
14. Four-stage
15. Jetting
16. Trash pump

3. List four general classifications of pumps.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d ______________________________

4. List four power sources for pumps.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

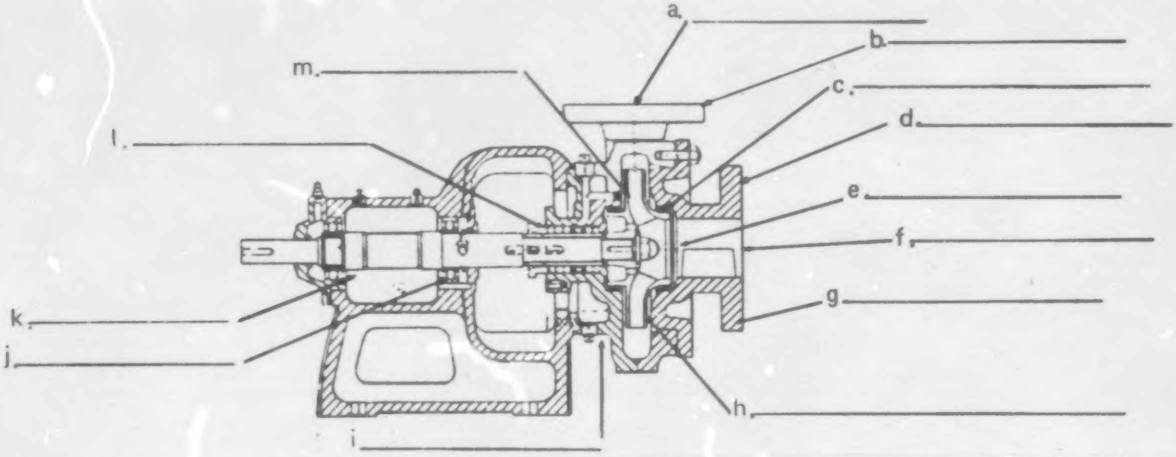
5. Distinguish between standard pump ratings in general use. Write "GPM" or "psi" in the blank before the statement to which each applies.

    _____a. Pressure at which liquid is moved

    _____b. Volume of liquid delivered by pump

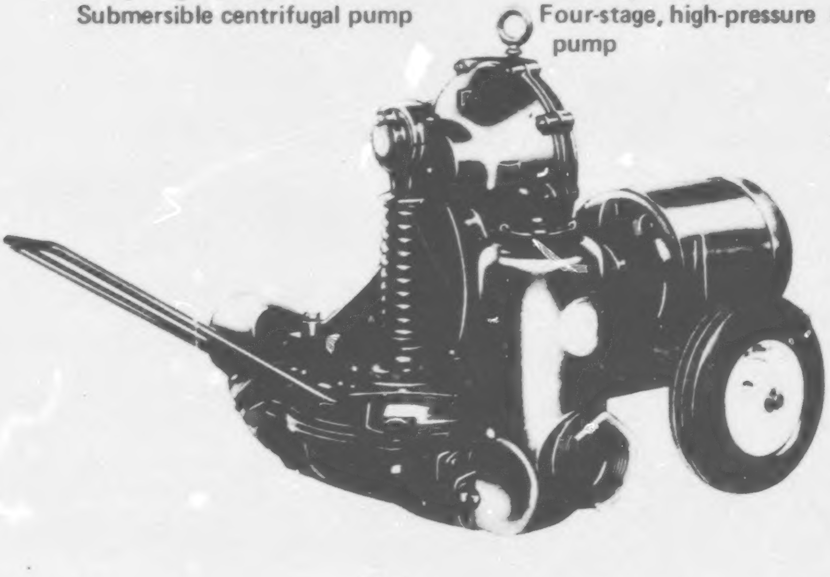
TEST

6. Label parts of a centrifugal pump. Write the correct names in the blanks.



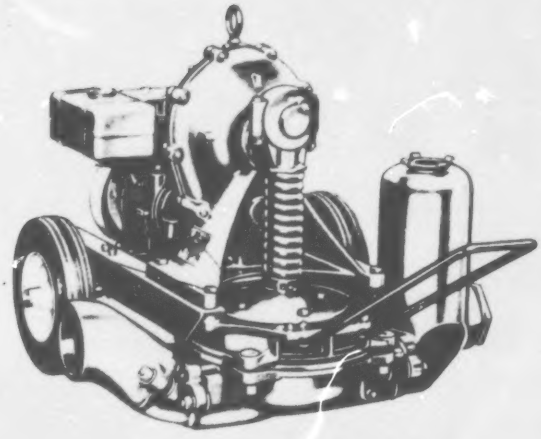
7. Identify types of pumps. Write the correct names in the blanks.

Portable air-powered diaphragm pump
Portable centrifugal petroleum pump
Portable electric-motor-driven diaphragm pump
Submersible centrifugal pump
Skid-mounted, self-priming centrifugal pump
Portable gasoline-engine-driven diaphragm pump
Trailer-mounted, high-pressure centrifugal pump
Caisson pump
Four-stage, high-pressure centrifugal jetting pump

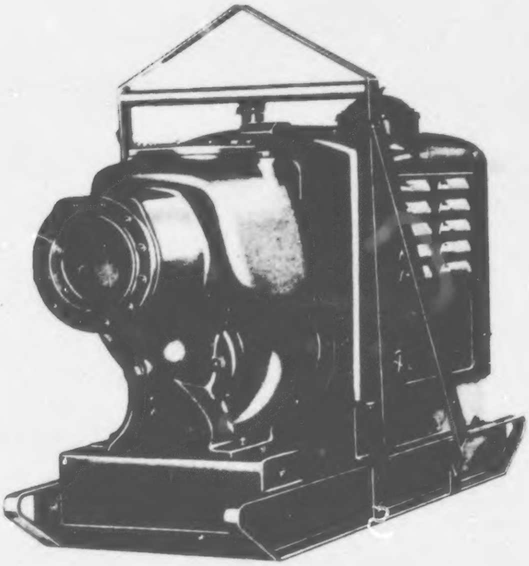


a. ________________________

TEST

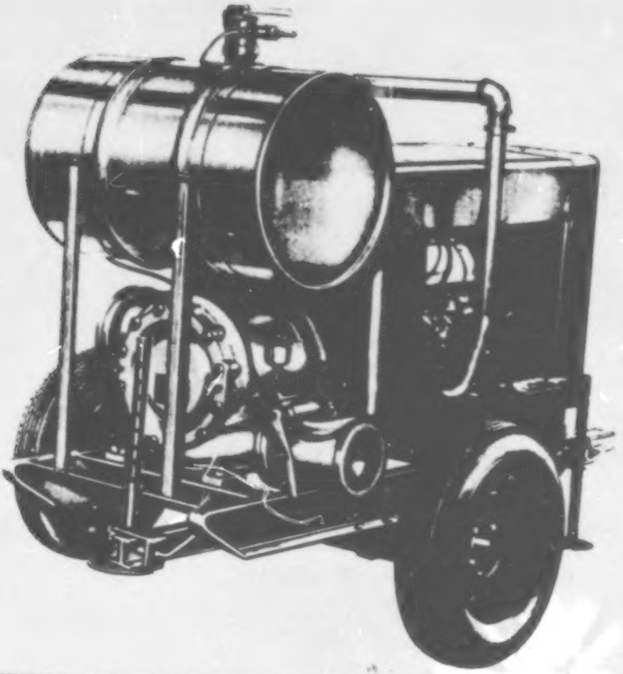


b. ______________________________

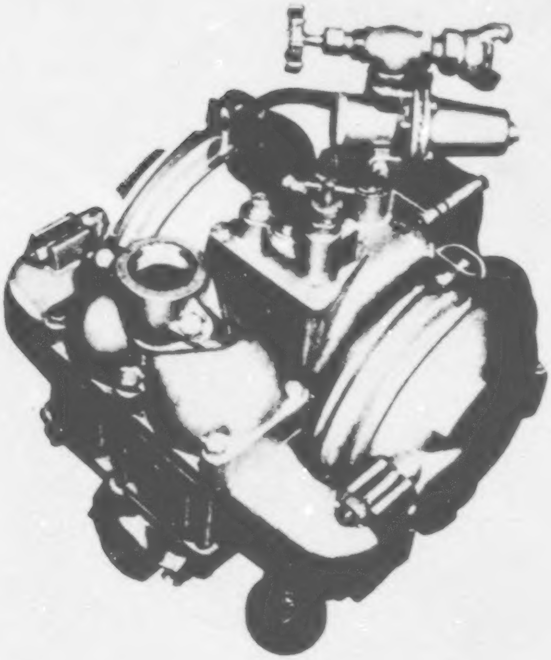


c. ______________________________

TEST

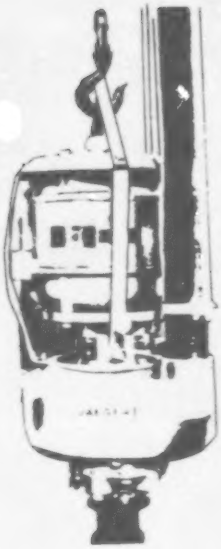


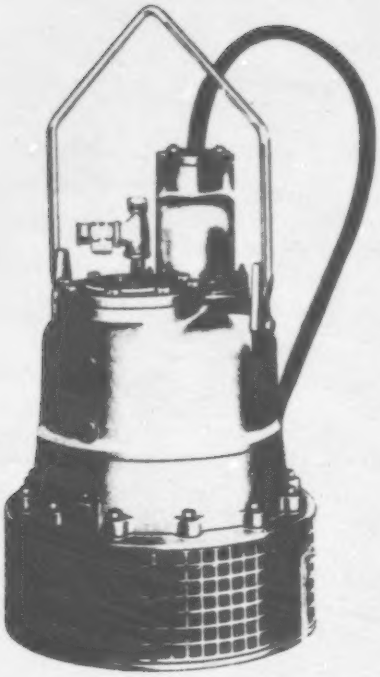
d. ____________________



e. ____________________

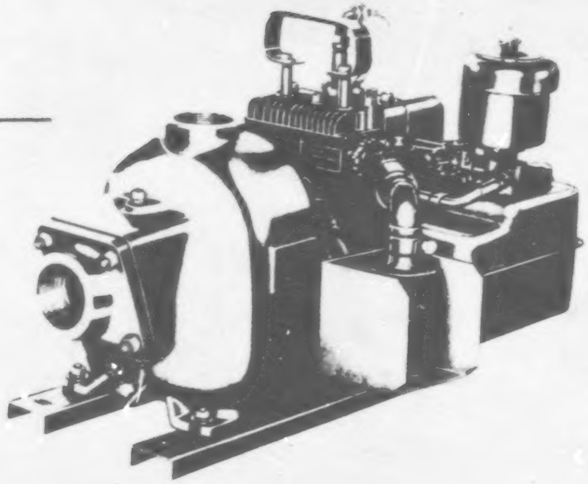
TEST





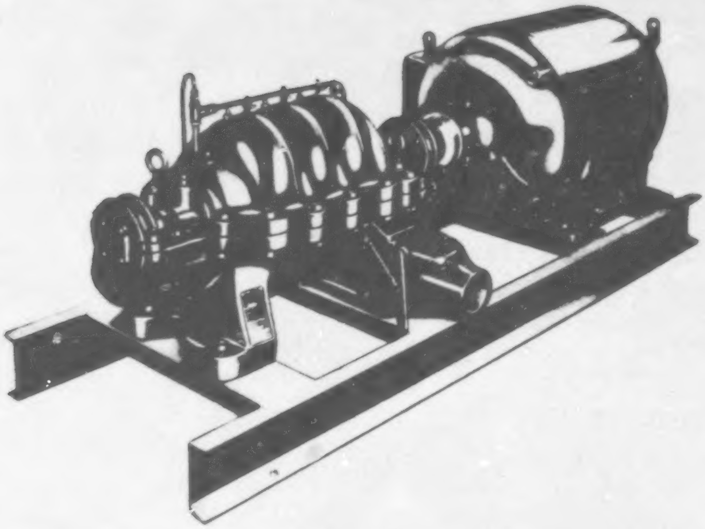
g. ______________________________

f. ______________________________



h. ______________________________

TEST



i. ______________________

8. State four suggestions for effective pump operation.

   a. ____

   ____

   b. ____

   ____

   c. ____

   ____

   d. ____

   ____

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Service a pump.

   b. Start and prime a pump.

PUMPS
UNIT I

ANSWERS TO TEST

1. Answer should include any five of the following
   - a. Dewatering
   - b. Bridgework
   - c. Jet piling
   - d. Excavation pumping
   - e. General transfer
   - f. Waste handling
   - g. Fire fighting
   - h. Irrigation

2. a. 5
   - b. 10
   - c. 7
   - d. 2
   - e. 6
   - f. 9
   - g. 3
   - h. 1
   - i. 8
   - j. 4
   - k. 11
   - l. 14
   - m. 13
   - n. 15
   - o. 12
   - p. 16

3. Answer should include any four of the following
   - a. Centrifugal
   - b. Reciprocating
   - c. Diaphragm
   - d. Propeller
   - e. Turbine
   - f. Rotary
   - g. Helical

4. Answer should include any four of the following
   - a. Gasoline engine
   - b. Diesel engine
   - c. Air
   - d. Steam
   - e. Electricity (AC and DC)
   - f. LPG engine

5. a. psi
   - b. GPM

ANSWERS TO TEST

6. a. Discharge point
   b. Discharge flange
   c. Wearing rings
   d. Suction flange
   e. Impeller
   f. Suction point
   g. Suction cover
   h. Impeller shrouds
   i. Casing
   j. Bearings
   k. Shaft
   l. Packing gland
   m. Impeller vanes

7. a. Portable electric-motor-driven diaphragm pump
   b. Portable gasoline-engine-driven diaphragm pump
   c. Skid-mounted, self-priming centrifugal pump
   d. Trailer-mounted, high-pressure centrifugal pump
   e. Portable air-powered diaphragm pump
   f. Caisson pump
   g. Submersible centrifugal pump
   h. Portable centrifugal petroleum pump
   i. Four-stage, high-pressure centrifugal jetting pump

8. Answer should include any four of the following
   a. Avoid sharp turns or abrupt changes in pipe or hose size
   b. Avoid air leaks in the inlet line
   c. Keep inlet strainer free of debris
   d. Install a foot valve above strainer on inlet to prevent hose from draining when pump is shut down
   e. Place pump as near the water level as possible since liquids can be pushed much easier than they can be pulled
   f. Protect pump and hose against freezing
   g. Inspect and service pumps regularly

9. Performance skills evaluated to the satisfaction of the instructor

COMPRESSORS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to start and operate an air compressor. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of air compressors.
2. Match terms associated with compressors to their correct definitions.
3. Distinguish between major types of compressors.
4. List specific types of compressors.
5. Select from a list types of power used to drive compressors.
6. Match classifications of compressors to their correct operations.
7. Describe how compressors are rated.
8. Select from a list items to check before starting a reciprocating compressor unit.
9. Demonstrate the ability to
    a. Perform daily check on a compressor.
    b. Start an air compressor.

COMPRESSORS
UNIT II

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Obtain and use materials for reference, motivation, and complete study of the equipment.

   G. Give test.

II. Instructional materials

   A. Objective sheet

   B Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Perform Daily Check on a Compressor

      2. Job Sheet #2--Start an Air Compressor

   E. Test

   F. Answers to test

III. Unit reference--Nichols, Herbert L. *Moving the Earth,* 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

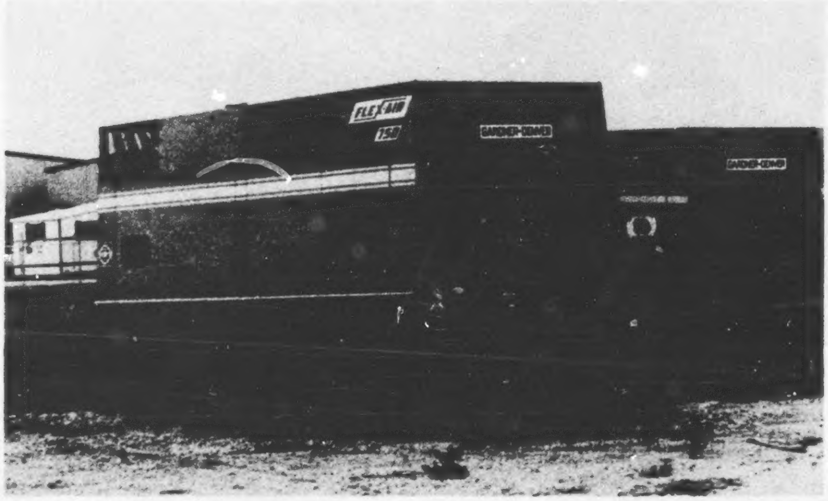
COMPRESSORS
UNIT II

INFORMATION SHEET

I. Uses of air compressors (Figure 1)

- A. Air hammers for breaking concrete
- B. Air drills for drilling rock or earth
- C. Air tampers for compacting
- D. Power source for pile drivers
- E. Power source for pneumatic tools
- F. Power source for pumps and hoists
- G. Sandblasting equipment
- H. Gunite equipment

FIGURE 1



II. Terms and definitions

- A. Compressor--Equipment that compresses air under pressure greater than that of the atmosphere
- B. Pneumatic--Powered or inflated by compressed air
- C. Intercooler--Radiator in which air is cooled while moving from low pressure to high pressure cylinders of a two-stage compressor

INFORMATION SHEET

D. Axial flow--Relatively constant flow of air through blades mounted on a rotor

E. Centrifugal--Moving in a direction away from the center of an axis

F. CFM or cfm--Cubic feet per minute; standard capacity or performance measurement for compressors

G. Stages (single and multi)--Number of steps a reciprocating compressor uses to compress air to final pressure

H. Reciprocating--Alternating back-and-forth motion of pistons

I. Dynamic--Force created by rapid turning of rotor blades

J. Rotor--Part that revolves in a stationary housing

K. Sandblasting--System of cutting or abrading a surface (concrete or metal) with a stream of sand forced from a nozzle at high speed by compressed air

L. Gunite--Method of applying concrete material to a surface through a gun using compressed air

M. Positive displacement--Type of compressor that confines and compresses air within a closed space by reducing the volume of space

N. Diaphragm--Thin, flexible material fastened securely around a perimeter with a center that moves back and forth to provide displacing action

III. Difference between major types of compressors

A. Positive displacement--Confines and compresses air by reducing the volume of space

(NOTE: Some types are capable of compressing air to high pressures.)

B. Dynamic--Accelerates air with rapidly turning rotor blades, which tends to raise pressure slightly

IV. Specific types of compressors

(NOTE: Air compressors are usually classified into two general categories--positive displacement and dynamic.)

A. Positive displacement

1. Reciprocating (piston)
2. Rotary screw
3. Diaphragm

INFORMATION SHEET

4. Rotary lobe or impeller

5. Rotary vane

B. Dynamic (centrifugal)

1. Single-stage

2. Multistage (axial flow)

(NOTE: These are only a few of the many specific types.)

V. Types of power used to drive compressors

A. Diesel engine

B. Gasoline engine

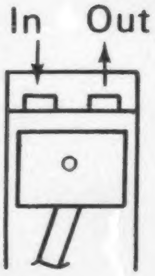
C. Electric motor (portable and stationary)

(NOTE: Compressors may be mounted on trucks, tractors, or trailers [two-wheel and four-wheel], or they may be skid mounted.)

VI. Operations of classifications of compressors

A. Single-stage--Draws air in at atmospheric pressure and compresses it to final pressure in one stroke (Figure 2)

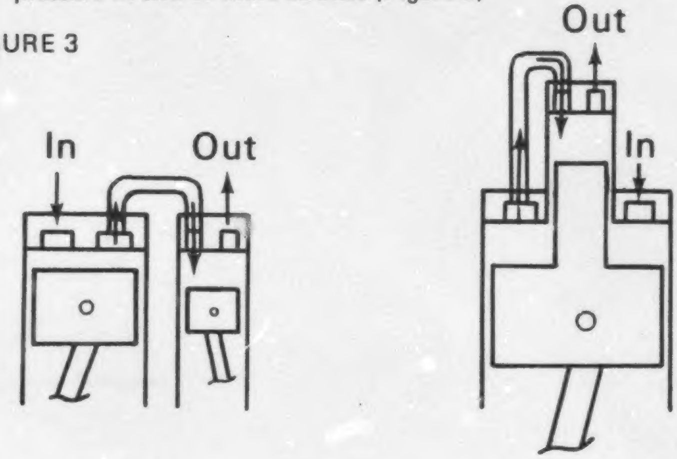
FIGURE 2



INFORMATION SHEET

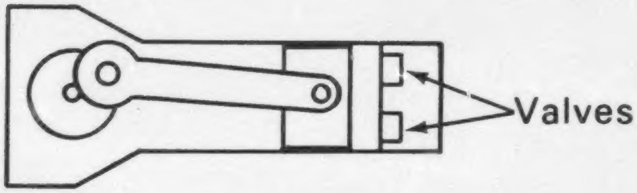
B. Multistage--Draws air in at atmospheric pressure and compresses it to final pressure in two or more strokes (Figure 3)

FIGURE 3


In
Out
Out
In

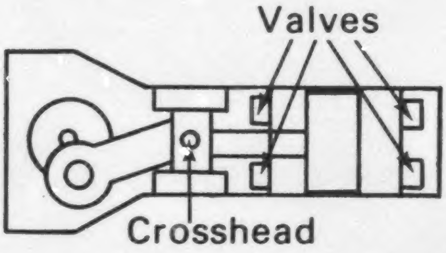
C. Single-acting--Compresses air at one end of cylinder only (Figure 4)

FIGURE 4



D. Double-acting (crosshead)--Compresses air at both ends of cylinder (Figure 5)

FIGURE 5


Valves
Crosshead

INFORMATION SHEET

VII. How compressors are rated--According to the number of cubic feet of air they take in each minute when working at maximum governed speed with a specified pressure, usually 100 pounds, at the discharge

VIII. Items to check before starting a reciprocating compressor unit

A. Engine oil level

B. Engine coolant level

C. Battery electrolyte level and cable connections

D. Fuel level

E. Air cleaner

F. Wires, insulation, and connections

G. Drive belt adjustment and condition

H. Fuel pump sediment bowl (where applicable)

I. Exhaust system

J. Safety devices

K. Cleanliness of equipment

L. Compressor oil level

M. Open receiver drain cock

N. Disengagement of clutch

O. Drain air receiver (air tank)

P. Gauges for normal operation

Q. Controls for proper functioning

R. Air lines, connectors, and valves

S. Accessory oiling system (where applicable)

T. Accessory condition

COMPRESSORS
UNIT II

JOB SHEET #1--PERFORM DAILY CHECK ON A COMPRESSOR

I. Equipment and materials

- A. Reciprocating compressor
- B. Tool kit
- C. Engine oil
- D. Cleaning solvent
- E. Engine coolant
- F. Battery electrolyte or water
- G. Fuel
- H. Oil can spout
- I. Shop rags

II. Procedure

- A. Remove engine oil dipstick
- B. Wipe dipstick clean and replace
- C. Remove engine oil dipstick and check oil level; add oil if necessary
- D. Replace dipstick
- E. Remove radiator cap and check fluid level; add if necessary

  (CAUTION: Do not remove radiator cap unless engine is cool; then, open slowly to release pressure.)
- F. Check fuel tank level; fill if necessary
- G. Remove and check air cleaner filter; clean or replace if necessary
- H. Check all wiring connections and insulation; repair if necessary
- I. Check drive belt adjustment and condition; adjust or replace if necessary
- J. Check fuel pump sediment bowl; remove and clean if necessary
- K. Visually inspect exhaust system; repair if necessary
- L. Check all safety devices for proper functioning

JOB SHEET #1

M. Check cleanliness of equipment; clean if necessary

N. Remove dipstick from compressor and check level; add oil if necessary

O. Open receiver drain cock

P. Disengage clutch

Q. Open drain valve on air receiver to remove water caused from condensation

(NOTE: Air reciever should be drained occasionally during working hours, especially in hot, damp weather since condensation can amount to several gallons per day.)

R. Check all air lines, connectors, and valves for damage or leaks; repair as necessary

S. Check accessory oiling systems (in line oiler); fill if necessary

T. Check accessory for worn or broken parts and for leaks; repair if necessary

U. Start and warm up engine

V. Engage clutch

W. Close receiver drain cock

X. Check all gauges for normal operation; shut off engine and repair if abnormal

Y. Manipulate controls to check proper functioning; if not functioning properly, repair as necessary

COMPRESSORS
UNIT II

JOB SHEET #2--START AN AIR COMPRESSOR

I. Equipment-Air compressor

II. Procedure

A. Complete daily inspection

B. Open receiver drain cock

C. Disengage clutch

D. Turn ignition on

E. Start engine

F. Check all gauges to see that they are operating normally

G. Warm up engine for several minutes

(NOTE: If engine is not thoroughly warm or is in poor condition, it may not be able to build up full receiver pressure immediately. If it threatens to stall, disengage clutch, unload compressor by hand control, and allow extra warm-up time.)

H. Engage clutch

I. Close drain cock

J. Open drain in bottom of receiver occasionally to drain condensation

K. Trip safety valves by hand on the receiver and the intercooler at least once a day to blow out carbon and/or sludge deposits

(NOTE: Once the compressor is started, the operation is completely automatic except for checking gauges for normal operation and keeping air pressure up.)

COMPRESSORS
UNIT II

TEST

NAME ______________________ SCORE ____________

1. List three uses of air compressors.

   a. ________________________________

   b. ________________________________

   c. ________________________________

2. Match terms associated with compressors to their correct definitions. Write the correct numbers in the blanks. Definitions are continued on the next page.

_____a. Equipment that compresses air under pressure greater than that of the atmosphere

_____b. Relatively constant flow of air through blades mounted on a rotor

_____c. Powered or inflated by compressed air

_____d. Radiator in which air is cooled while moving from low pressure to high pressure cylinders of a two-stage compressor

_____e. Moving in a direction away from the center of an axis

_____f. Number of steps a reciprocating compressor uses to compress air to final pressure

_____g. Alternating back-and-forth motion of pistons

_____h. Force created by rapid turning of rotor blades

_____i. Part that revolves in a stationary housing

_____j. Cubic feet per minute; standard capacity or performance measurement for compressors

_____k. System of cutting or abrading a surface (concrete or metal) with a stream of sand forced from a nozzle at high speed by compressed air

1. Intercooler
2. Reciprocating
3. Rotor
4. Dynamic
5. CFM or cfm
6. Compressor
7. Stages (single and multi)
8. Pneumatic
9. Axial flow
10. Sandblasting
11. Positive displacement
12. Gunite
13. Diaphragm
14. Centrifugal

TEST

_____l. Type of compressor that confines and compresses air within a closed space by reducing the volume of space

_____m. Thin, flexible material fastened securely around a perimeter with a center that moves back and forth to provide displacing action

_____n. Method of applying concrete material to a surface through a gun using compressed air

3. Distinguish between major types of compressors. Write a "P" in the blank before the description of positive-displacement and a "D" in the blank before the description of dynamic.

_____a. Accelerates air with rapidly turning rotor blades, which tends to raise pressure slightly

_____b. Confines and compresses air by reducing the volume of space

4. List two of each of the following specific types of compressors.

a. Positive displacement

1) ____________________

2) ____________________

b. Dynamic (centrifugal)

1) ____________________

2) ____________________

5. Select from the following list types of power used to drive compressors. Write an "X" in the blank before each correct answer.

_____a. Air

_____b. Steam

_____c. Electric motor (portable and stationary)

_____d. Manual

_____e. Gasoline engine

_____f. Diesel engine

TEST

6. Match classifications of compressors to their correct operations. Write the correct numbers in the blanks.

_____a. Draws air in at atmospheric pressure and compresses it to final pressure in one stroke

_____b. Draws air in at atmospheric pressure and compresses it to final pressure in two or more strokes

_____c. Compresses air at one end of cylinder only

_____d. Compresses air at both ends of cylinder

1. Multistage
2. Double-acting (crosshead)
3. Single-stage
4. Single-acting

7. Describe how compressors are rated.

____

____

____

____

8. Select from the following list items to check before starting a reciprocating compressor unit. Write an "X" in the blank before each correct answer.

_____a. Gauges for normal operation

_____b. Exhaust system

_____c. Engine coolant level

_____d. Air lines, connectors, and valves

_____e. Air receiver fluid level

_____f. Engine oil level

_____g. Compressor oil level

_____h. Clutch plates

_____i. Drive belt adjustment and condition

_____j. Safety devices

_____k. Accessory oiling system (where applicable)

_____l. Viscosity of compressor oil

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TEST

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Perform daily check on a compressor.

   b. Start an air compressor.

COMPRESSORS
UNIT II

ANSWERS TO TEST

1. Answer should include any three of the following
   - a. Air hammers for breaking concrete
   - b. Air drills for drilling rock or earth
   - c. Air tampers for compacting
   - d. Power source for pile drivers
   - e. Power source for pneumatic tools
   - f. Power source for pumps and hoists
   - g. Sandblasting equipment
   - h. Gunite equipment

2.

a.	6	f.	7	k.	10
b.	9	g.	2	l.	11
c.	8	h.	4	m.	13
d.	1	i.	3	n.	12
e.	14	j.	5		

3. a. D

   b. P

4. a. Answer should include any two of the following
   - 1) Reciprocating (piston)
   - 2) Rotary screw
   - 3) Diaphragm
   - 4) Rotary lobe or impeller
   - 5) Rotary vane

ANSWERS TO TEST

   b. Answer should include the following

      1) Single-stage

      2) Multistage (axial flow)

5. c, e, f

6. a. 3

   b. 1

   c. 4

   d. 2

7. Description should include the following--According to the number of cubic feet of air they take in each minute when working at maximum governed speed with a specified pressure, usually 100 pounds, at the discharge

8. a, b, c, d, f, g, i, j, k

9. Performance skills evaluated to the satisfaction of the instructor

VIBRATORS
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to install a compactor on a backhoe and be able to use equipment to compact a ditch. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List job applications for vibrators.
2. Match terms associated with vibrators to their correct definitions.
3. List benefits of using backhoe-mounted compactors.
4. List types of vibrators.
5. State safety rules related to vibrators.
6. Demonstrate the ability to
    a. Install compactor on backhoe.
    b. Compact a ditch.

VIBRATORS
UNIT III

SUGGESTED ACTIVITIES

I. Suggested activities

- A. Provide students with objective sheet.
- B. Provide students with information and job sheets.
- C. Discuss unit and specific objectives.
- D. Discuss information sheet.
- E. Demonstrate and discuss procedures outlined in job sheets.
- F. Obtain and use materials for reference, motivation, and complete study of the equipment.
- G. Give test.

II. Instructional materials

- A. Objective sheet
- B. Suggested activities
- C. Information sheet
- D. Job sheets
  1. Job Sheet #1--Install Compactor on Backhoe
  2. Job Sheet #2--Compact a Ditch
- E. Test
- F. Answers to test

III. Unit references

- A. "Contech Crusher." Denver, Colorado: Contech Products, Consolidated Technologies Corp, n.d.
- B. *Model 33 Rapid-Ram Hydraulic Impact Hammer Owner's Manual.* Cleveland, Ohio: Allied Steel & Tractor Products, Inc., 1973.

VIBRATORS
UNIT III

INFORMATION SHEET

I. Job applications for vibrators

   A. Compacting trenches

   B. Compacting curbsides and footings

   C. Compacting foundation walls

   D. Compacting jobs where large compactors are not practical

II. Terms and definitions

   A. Vibrator--Machine with an offset cam or flywheel that sets up a thumping action

   B. Compacting--Means of making materials more dense

   C. Compaction--Reduction in bulk of fill by rolling, tamping, or soaking

   D. Lift--Stockpiled soil placed in a ditch in layers and compacted to specifications

   E. Traffic flow--Direction other equipment is moving

   F. Fill--Material needed to bring existing ground to desired grade

III. Benefits of using backhoe-mounted compactors

   A. Better compaction than small units

   B. Deep lifts

   C. Economical

   D. Profitable

   E. Safe to use, especially in trenching operations

   F. Can be used in areas that are too small for large compactors

IV. Types of vibrators

   A. Backhoe-mounted hydraulic compactor

   B. Excavator-mounted hydraulic compactor

INFORMATION SHEET

    C. Backhoe-mounted air compactor
    D. Excavator-mounted air compactor
    E. Single-drum vibrating roller (walking type)
    F. Double-drum vibrating roller (walking type)
    G. Riding-type vibrating roller
    H. Towed vibrating roller

V. Safety rules related to vibrators

    A. Know positions and functions of all controls
    B. Operate equipment only if you are qualified
    C. Observe all safety regulations
    D. Know and observe all hand signals
    E. Correct or report any possible defects in equipment
    F. Note hazards and/or obstructions and take necessary precautions
    G. Never leave equipment running unattended
    H. Know and observe traffic flow patterns

VIBRATORS
UNIT III

JOB SHEET #1--INSTALL COMPACTOR ON BACKHOE

I. Equipment and materials

- A. Backhoe
- B. Bucket
- C. Hydraulic compactor

II. Procedure

- A. Start backhoe
- B. Position bucket on the ground in a position that takes strain off mounting pins
- C. Pull pins out when pressure is taken off

  (NOTE: Sometimes it is necessary to maneuver controls to help take pressure off pins.)
- D. Move backhoe to compactor location

  (NOTE: Usually, compactor is left on blocks in a position that is ready for connecting.)
- E. Maneuver controls to lower boom in a position to make connections on compactor
- F. Maneuver controls so that ground crew will be able to insert mounting pins
- G. Use clips to secure hydraulic hose along length of boom
- H. Connect hydraulic hose to backhoe, using quick-disconnect connectors
- I. Operate controls to check compactor operation

VIBRATORS
UNIT III

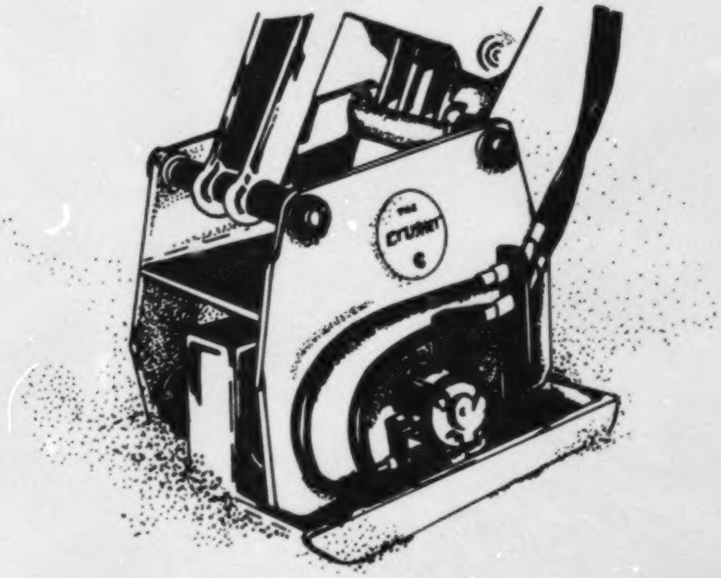
JOB SHEET #2--COMPACT A DITCH

I. Equipment and materials

A. Backhoe

B. Hydraulic vibrating compactor (Figure 1)

FIGURE 1



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II. Procedure

A. Mount backhoe and start engine

B. Raise outriggers (stabilizers)

C. Raise loader bucket

D. Place boom in transport position

E. Travel to ditch location

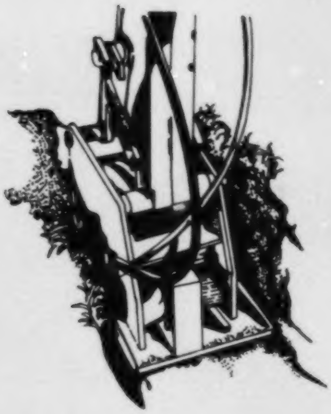
F. Set up backhoe at beginning of ditch

G. Lower compactor to ditch

JOB SHEET #2

H. Use bucket control to activate compactor and begin compacting first lift (Figure 2)

FIGURE 2



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I. Continue compacting first lift while moving backward

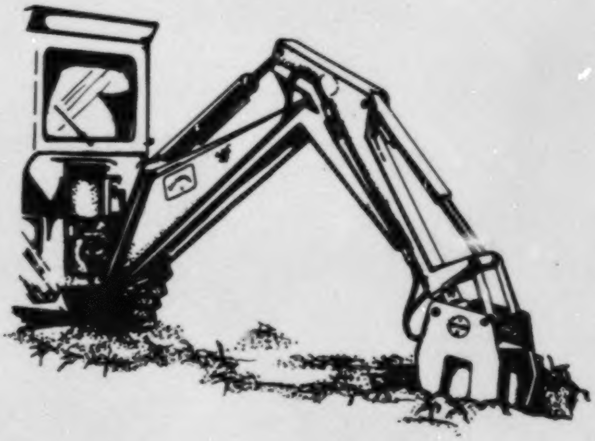
J. When first lift is complete, move back to beginning

K. Begin compacting second lift

L. Continue compacting second lift while moving backward

M. Continue this procedure until ditch is completed (Figure 3)

FIGURE 3



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VIBRATORS
UNIT III

TEST

NAME______________________________ SCORE______________

1. List job applications for vibrators.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

2. Match terms associated with vibrators to their correct definitions. Write the correct numbers in the blanks.

   _____a. Machine with an offset cam or flywheel that sets up a thumping action

   _____b. Means of making materials more dense

   _____c. Reduction in bulk of fill by rolling, tamping, or soaking

   _____d. Stockpiled soil placed in a ditch in layers and compacted to specifications

   _____e. Direction other equipment is moving

   _____f. Material needed to bring existing ground to desired grade

   1. Compacting
   2. Fill
   3. Lift
   4. Vibrator
   5. Traffic flow
   6. Compaction

3. List three benefits of using backhoe-mounted compactors.

   a. ______________________________

   b. ______________________________

   c. ______________________________

4. List five types of vibrators.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

TEST

5. State five safety rules related to vibrators.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

(NOTE: Test question 6 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Demonstrate the ability to

a. Install compactor on backhoe.

b. Compact a ditch.

VIBRATORS
UNIT III

ANSWERS TO TEST

1. a. Compacting trenches
   b. Compacting curbsides and footings
   c. Compacting foundation walls
   d. Compacting jobs where large compactors are not practical

2. a. 4 d. 3
   b. 1 e. 5
   c. 6 f. 2

3. Answer should include any three of the following
   a. Better compaction than small units
   b. Deep lifts
   c. Economical
   d. Profitable
   e. Safe to use, especially in trenching operations
   f. Can be used in areas that are too small for large compactors

4. Answer should include any five of the following
   a. Backhoe-mounted hydraulic compactor
   b. Excavator-mounted hydraulic compactor
   c. Backhoe-mounted air compactor
   d. Excavator-mounted air compactor
   e. Single-drum vibrating roller (walking type)
   f. Double-drum vibrating roller (walking type)
   g. Riding-type vibrating roller
   h. Towed vibrating roller

ANSWERS TO TEST

5. Answer should include any five of the following
    - a. Know positions and functions of all controls
    - b. Operate equipment only if you are qualified
    - c. Observe all safety regulations
    - d. Know and observe all hand signals
    - e. Correct or report any possible defects in equipment
    - f. Note hazards and/or obstructions and take necessary precautions
    - g. Never leave equipment running unattended
    - h. Know and observe traffic flow patterns

6. Performance skills evaluated to the satisfaction of the instructor

PAVING BREAKERS
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to identify types of paving breakers and accessories. The student should also be able to perform service on hydraulic and air hammers. This knowledge will be shown by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of paving breakers.
2. Match terms associated with paving breakers to their correct definitions.
3. Identify types of paving breakers.
4. Select from a list variables to consider when figuring rate of demolition.
5. State safety rules related to paving breakers.
6. Demonstrate the ability to
    a. Perform daily inspection on a hydraulic hammer.
    b. Perform daily inspection on an air hammer.
    c. Use a paving breaker to break out a slab.

PAVING BREAKERS
UNIT IV

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Obtain and use materials for reference, motivation, and complete study of the equipment.

   G. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Perform Daily Inspection on a Hydraulic Hammer

      2. Job Sheet #2--Perform Daily Inspection on an Air Hammer

      3. Job Sheet #3--Use a Paving Breaker to Break Out a Slab

   E. Test

   F. Answers to test

III. Unit references

   A. *Contech Products Pamphlet*. Denver, Colorado: Contech Products, Consolidated Technologies Corp., n.d.

   B. Nichols, Herbert L. *Moving the Earth*, 3rd ed. Greenwich, Connecticut: North Castle Books, 1976.

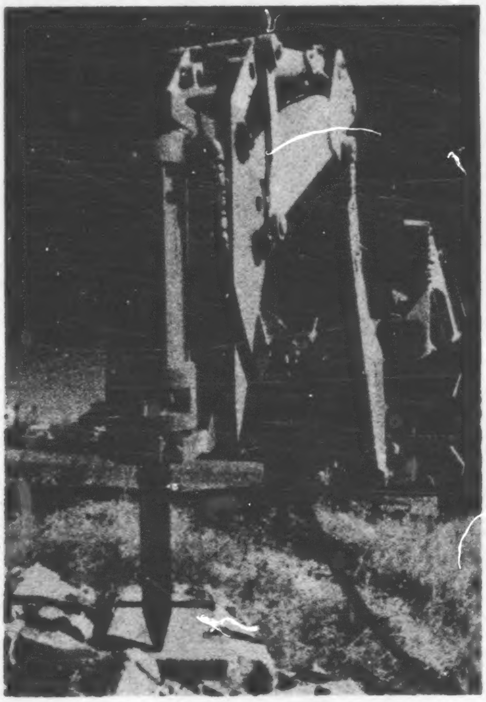
PAVING BREAKERS
UNIT IV

INFORMATION SHEET

I. Uses of paving breakers (Figure 1)

- A. Breaking and scaling rock and other materials in mines and quarries
- B. Breaking out concrete
- C. Refurbishing operations in smelter plants
- D. Recycling concrete

FIGURE 1



Courtesy of Consolidated Technologies Corporation.

II. Terms and definitions

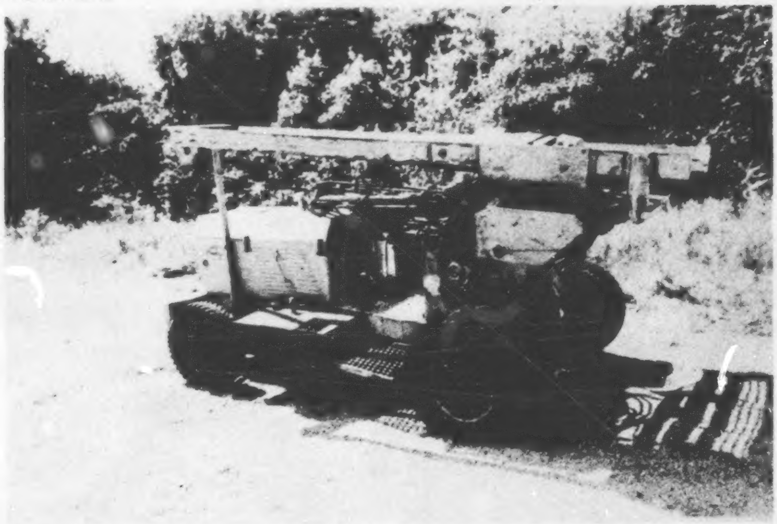
- A. Scaling--Peeling away of a surface or prying pieces of rock off of a surface
- B. Refurbish--Renovate; to restore or make like new
- C. Recycle--To process in order to reuse material
- D. Demolition--To tear down or destroy

INFORMATION SHEET

III. Types of paving breakers (Figures 2-6)

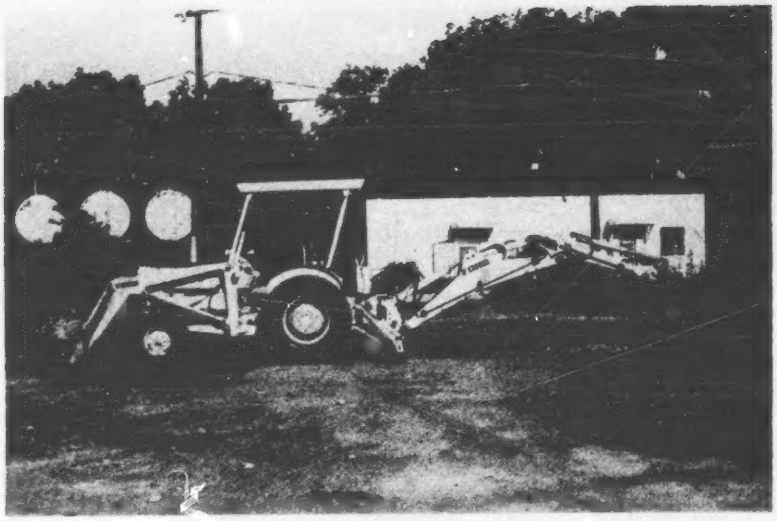
A. Mobile hydraulic hammer (tractor type)

FIGURE 2



B. Backhoe with breaker

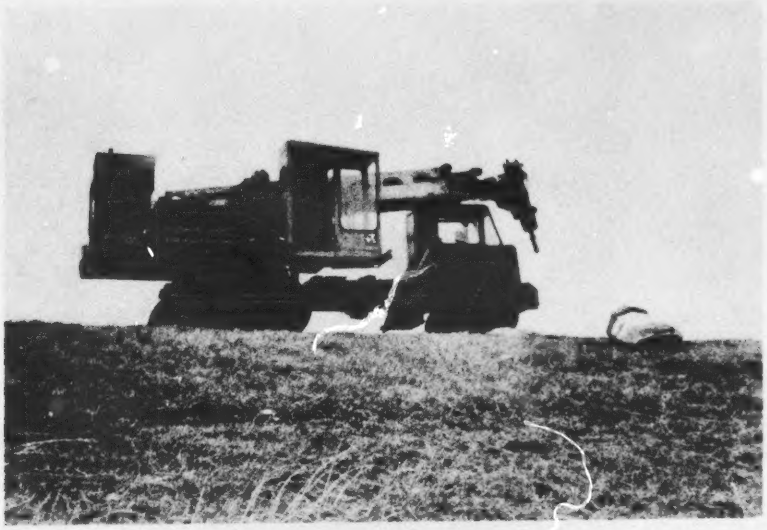
FIGURE 3



INFORMATION SHEET

C. Mobile unit with breaker

FIGURE 4



D. Pedestal-mounted breaker

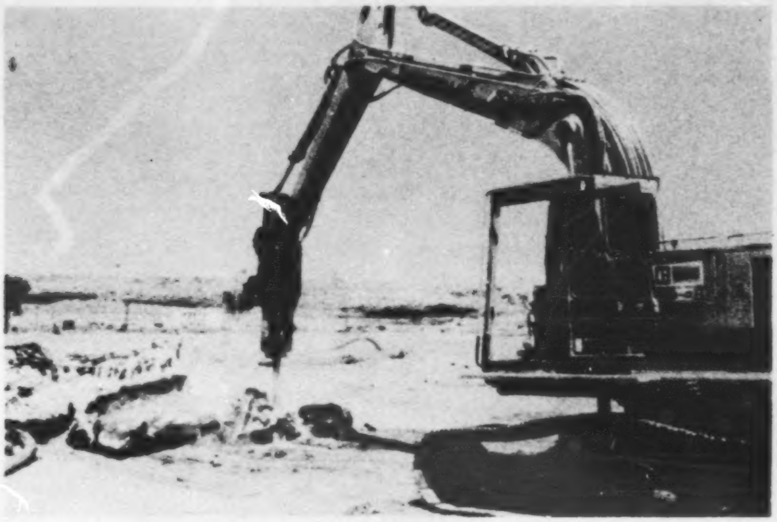
FIGURE 5

Courtesy of Consolidated Technologies Corporation.

INFORMATION SHEET

E. Hydraulic excavator with breaker

FIGURE 6



Courtesy of Consolidated Technologies Corporation.

IV. Variables to consider when figuring rate of demolition

A. Nature of work

B. Quality of work

C. Area of material being broken

D. Size and weight of hammer being used

E. Reinforcing in the material

F. Type of equipment used

G. Condition of equipment

H. Skill of the operator

INFORMATION SHEET

V. Safety rules related to paving breakers

   A. Wear approved protective clothing and safety items where and when required

   B. Keep hands and feet away from cutting tip

   C. Keep all guards in place

   D. Use caution when operating with a helper

   E. Keep hammer under control at all times

   F. Do not operate equipment with worn or broken parts

   G. Keep equipment, especially controls and gauges, as clean as possible

   H. Be sure air is turned off before changing hammers or bits on air-operated equipment

   I. Never operate equipment at pressures above manufacturer's rating

   J. Stay alert at all times; DO NOT HORSEPLAY

PAVING BREAKERS
UNIT IV

JOB SHEET #1--PERFORM DAILY INSPECTION ON A HYDRAULIC HAMMER

I. Equipment and materials

   A. Hammer

   B. Tool kit

   C. Hydraulic fluid

   D. Oil

   E. Shop rags

II. Procedure

   A. Inspect for broken, worn, loose, or missing parts

   B. Inspect condition of all hydraulic hoses and look for leaks

   C. Check grease fittings to be sure they have been greased

   D. Check oil in hammer; add if necessary

   E. Check automatic shutoff to make sure that it is operating properly

   F. Check tool locking device; be sure it is in locked position

   G. Check condition of tool bit or accessory

   H. Check hydraulic reservoir; fill if necessary

PAVING BREAKERS
UNIT IV

JOB SHEET #2–PERFORM DAILY INSPECTION ON AN AIR HAMMER

I. Equipment and materials

- A. Hammer
- B. Tool kit
- C. Oil
- D. Shop rags

II. Procedure

- A. Inspect for broken, worn, loose, or missing parts
- B. Inspect condition of all air lines and look for leaks
- C. Inspect tightness of coupling and look for leaks; replace neoprene washer if necessary
- D. Remove oil plug to check oil reservoir; add if necessary
- E. Check exhaust port to be sure it is open
- F. Check tool retainer; be sure it is in locked position
- G. Check throttle lever to be sure it is operating properly
- H. Check condition of tool bit or accessory

PAVING BREAKERS
UNIT IV

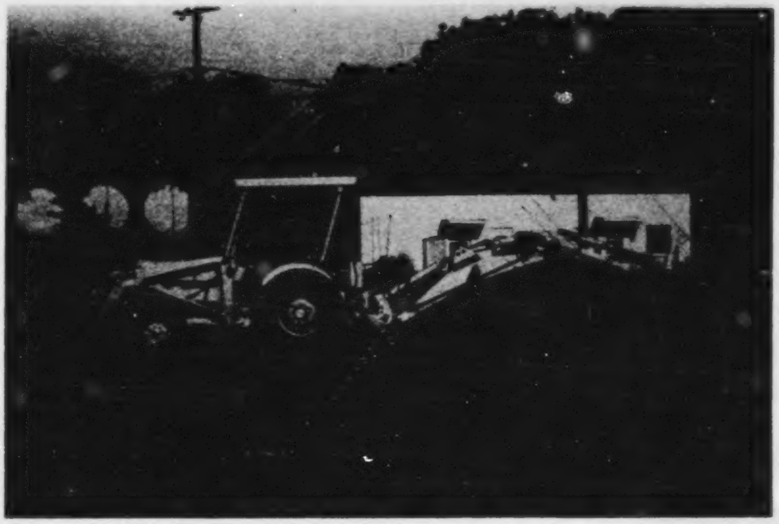
JOB SHEET #3–USE A PAVING BREAKER TO BREAK OUT A SLAB

I. Equipment

A. Backhoe (Figure 7)

B. Hydraulic breaker attachment

FIGURE 7



II. Procedure

A. Mount backhoe and start engine

B. Raise outriggers (stabilizers)

C. Raise loader bucket

D. Raise breaker attachment

E. Proceed to job location

F. Move to starting point and set up machine

G. Lower loader bucket to the ground enough to take pressure off of front tires

H. Move to backhoe controls

I. Lower outriggers to the ground until most of rear weight of backhoe is on the outriggers and backhoe is in a level position

JOB SHEET #3

J. Lower breaker to the ground (Figure 8)

FIGURE 8

K. Remove swing lock pin and boom lock pin (when applicable)

L. Position breaker to start busting concrete

M. Use foot control to engage hammer

N. Start breaking

O. Continue breaking until this area is completely broken

P. Move machine

Q. Raise breaker attachment

R. Raise outriggers

S. Raise loader bucket

(NOTE: When all the area is busted within reach of the backhoe, the backhoe will have to be moved far enough that the breaker can just barely reach the section that is already busted.)

T. Continue breaking operations until job is complete

PAVING BREAKERS
UNIT IV

TEST

NAME ______________________ SCORE ______________

1. List uses of paving breakers.

   a. ________________________________

   b. ________________________________

   c. ________________________________

   d. ________________________________

2. Match terms associated with paving breakers to their correct definitions. Write the correct numbers in the blanks.

   _____a. Peeling away of a surface or prying pieces of rock off of a surface

   _____b. Renovate; to restore or make like new

   _____c. To process in order to reuse material

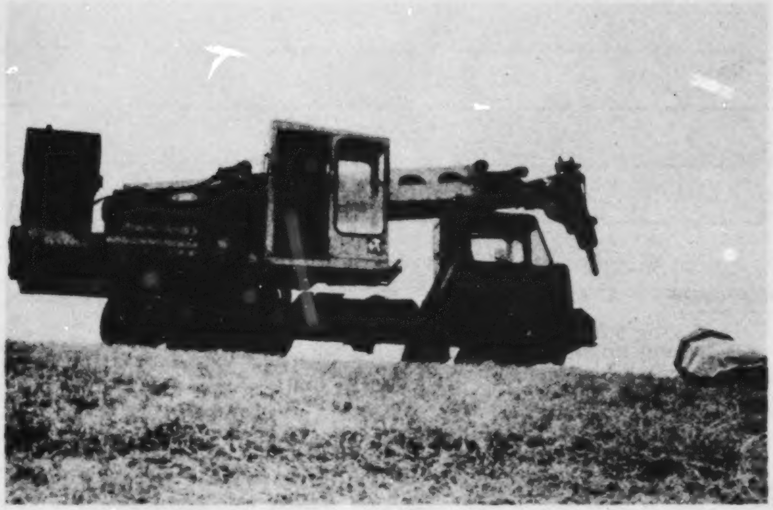
   _____d. To tear down or destroy

   1. Refurbish
   2. Demolition
   3. Scaling
   4. Recycle

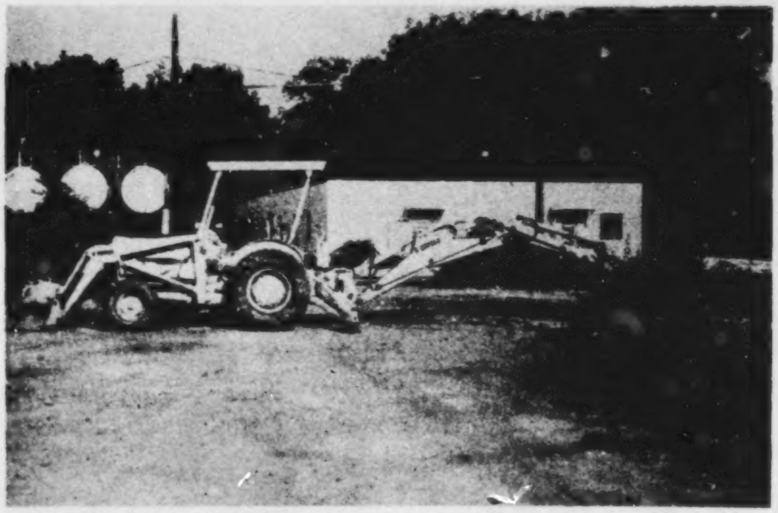
TEST

3. Identify types of paving breakers. Write the correct names in the blanks.

Backhoe with breaker
Mobile hydraulic hammer (tractor type)
Pedestal-mounted breaker
Hydraulic excavator with breaker
Mobile unit with breaker

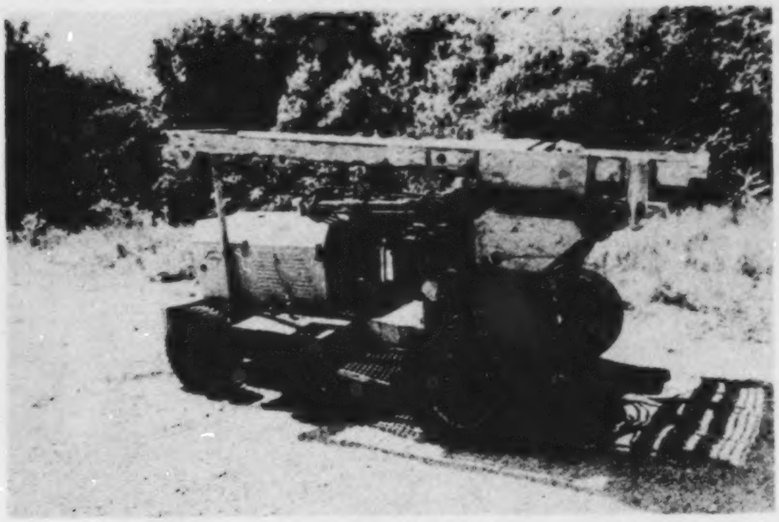


a. ______________________________

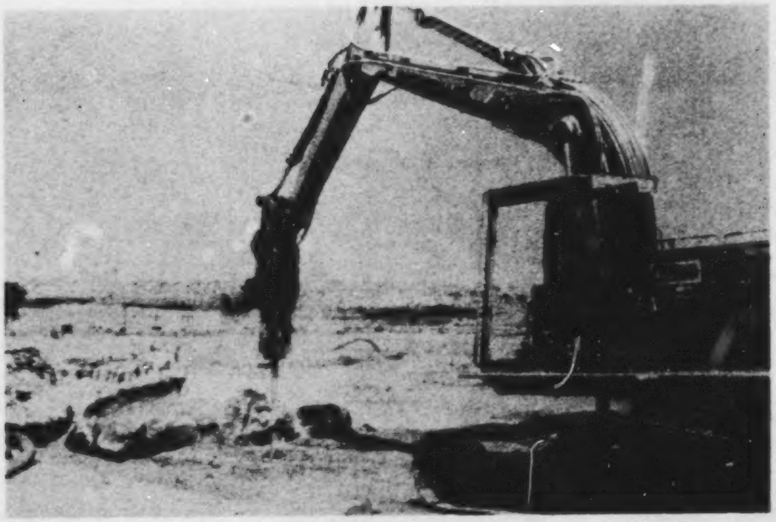


b. ______________________________

TEST

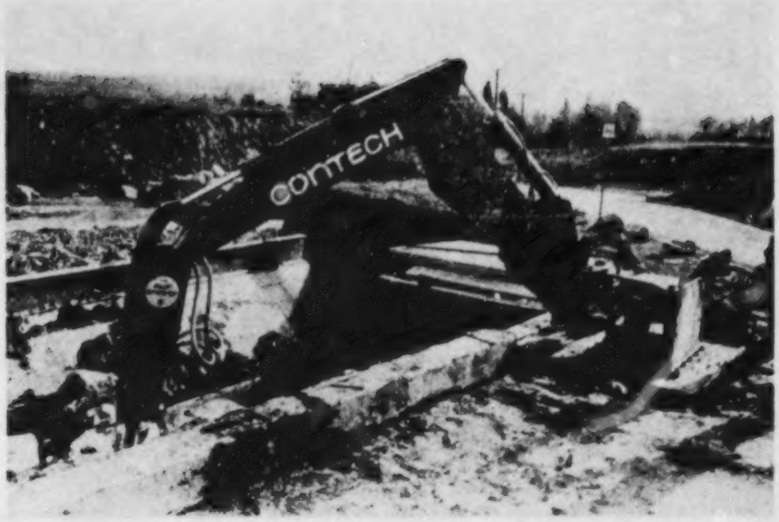


c. ______________________________



d. ______________________________

TEST



e. ______________________________

4. Select from the following list variables to consider when figuring rate of demolition. Write an "X" in the blank before each correct answer.

______a. Area of material being broken

______b. Type of equipment used

______c. Size and weight of hammer being used

______d. Operator's pay scale

______e. Nature of work

______f. Location of work

______g. Condition of equipment

______h. Skill of the operator

TEST

5. State seven safety rules related to paving breakers.

   a. ______________________________

   ____

   b. ______________________________

   ____

   c. ______________________________

   ____

   d. ______________________________

   ____

   e. ______________________________

   ____

   f. ______________________________

   ____

   g. ______________________________

   ____

(NOTE: Test question 6 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Demonstrate the ability to

   a. Perform daily inspection on a hydraulic hammer.

   b. Perform daily inspection on an air hammer.

   c. Use a paving breaker to break out a slab.

PAVING BREAKERS
UNIT IV

ANSWERS TO TEST

1. a. Breaking and scaling rock and other materials in mines and quarries
   b. Breaking out concrete
   c. Refurbishing operations in smelter plants
   d. Recycling concrete

2. a. 3
   b. 1
   c. 4
   d. 2

3. a. Mobile unit with breaker
   b. Backhoe with breaker
   c. Mobile hydraulic hammer (tractor type)
   d. Hydraulic excavator with breaker
   e. Pedestal-mounted breaker

4. a, b, c, e, g, h

5. Answers should include any seven of the following
   a. Wear approved protective clothing and safety items where and when required
   b. Keep hands and feet away from cutting tip
   c. Keep all guards in place
   d. Use caution when operating with a helper
   e. Keep hammer under control at all times
   f. Do not operate equipment with worn or broken parts

ANSWERS TO TEST

g. Keep equipment, especially controls and gauges, as clean as possible

h. Be sure air is turned off before changing hammers or bits on air-operated equipment

i. Never operate equipment at pressures above manufacturer's rating

j. Stay alert at all times; DO NOT HORSEPLAY

6. Performance skills evaluated to the satisfaction of the instructor

GENERATORS
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to perform daily inspection on a generator and should be able to operate an AC generator. This knowledge will be shown by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List uses of generators.
2. Match terms associated with generators to their correct definitions.
3. List types of generators.
4. Identify basic parts of an AC portable generator.
5. Describe the main reasons alternating current is used rather than direct current.
6. Demonstrate the ability to
    a. Perform daily inspection on a generator.
    b. Operate a portable AC generator.

GENERATORS
UNIT V

SUGGESTED ACTIVITIES

I. Suggested activities

   A. Provide students with objective sheet.

   B. Provide students with information and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Demonstrate and discuss procedures outlined in job sheets.

   F. Obtain and use materials for reference, motivation, and complete study of the equipment.

   G. Give test.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1--Perform Daily Inspection on a Generator

      2. Job Sheet #2--Operate a Portable AC Generator

   E. Test

   F. Answers to test

III. Unit references

   A. *Department of the Army Technical Manual: TM 5-6113-323-14*. Headquarters, Department of the Army and Air Force. Washington, D.C.: U.S. Government Printing Office, 1976.

   B. Hendrix, Laborn J., "Bud." *Construction Craftsman's Curriculum*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and the Associated General Contractors of America, 1978.

   C. Seastrom Rental Booklet, Indianapolis, Indiana, 1977.

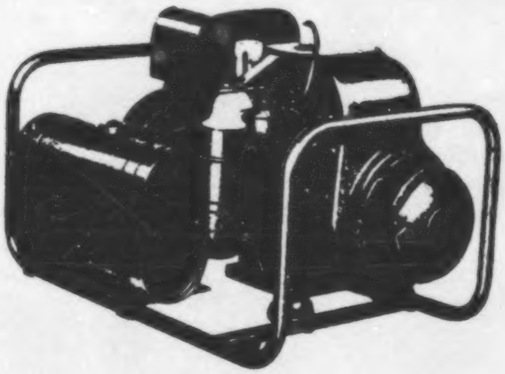
GENERATORS
UNIT V

INFORMATION SHEET

I. Uses of generators (Figure 1)

- A. Temporary lighting and floodlights
- B. Power source for electric hand tools
- C. Power source for battery chargers and boosters
- D. Power source for hoists and winches
- E. Power source for heavy equipment used in underground work
- F. Power source for welders

FIGURE 1



II. Terms and definitions

- A. Generator--Mechanically-driven machine used as a prime mover for steam or water turbines and gasoline or diesel engines; delivers electrical energy to electric lights or machines
- B. Dynamo--Machine that converts either mechanical energy to electrical energy or electrical energy to mechanical energy
- C. Turbine--Rotary engine driven by pressure of liquid or gas against its vanes

INFORMATION SHEET

D. AC--Alternating current; electric current that reverses its direction at regular intervals

E. DC--Direct current; electric current that flows in one direction and is constant in value

F. cps--Cycles per second

G. Variable resistor--Rotary control used to control output voltage of the generator

H. Load switch--Toggle switch used to connect and disconnect the generator to and from the load

I. Voltmeter--Graduated meter that indicates voltage at load terminals from 0 to 65 cps

J. Frequency meter--Graduated meter that indicates frequency of the generator from 0 to 65 cps

K. Cycle--Course or series of events or operations that recur regularly

L. Current--Movement of electric charges along a conductor; measured by means of a low-resistance ammeter

M. Frequency--Number of complete cycles passed through in one second

N. Voltage--Potential difference expressed in volts; measured by means of a high-resistance voltmeter

III. Types of generators

(NOTE: These units may be AC or DC current.)

A. Portable

B. Skid-mounted

C. Two-wheel trailer-mounted

D. Four-wheel trailer-mounted

E. Truck-mounted

(NOTE: Generators may be powered by gasoline or diesel engines.)

F. Welder-mounted

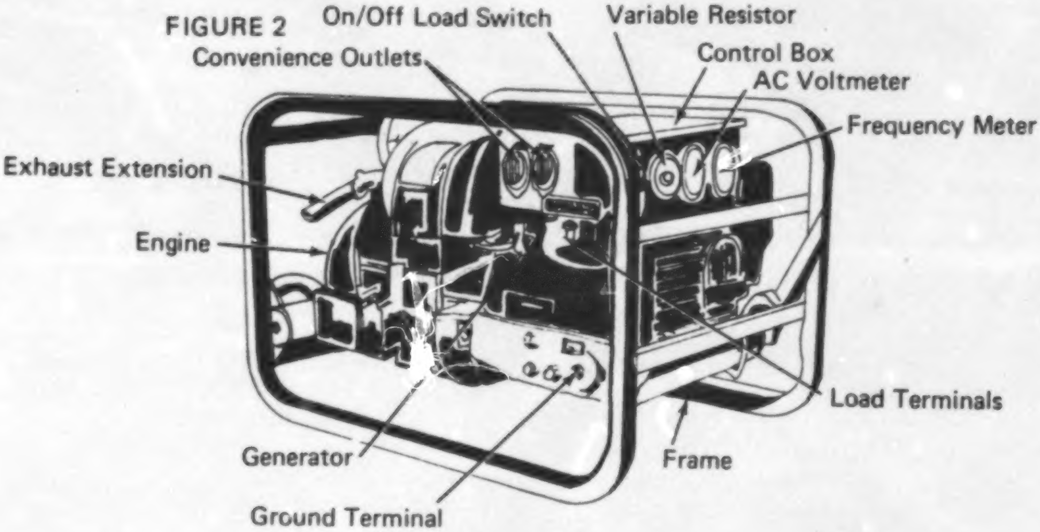
(NOTE: This generator may produce AC and/or DC current.)

INFORMATION SHEET

IV. Basic parts of an AC portable generator (Figures 2 and 3)

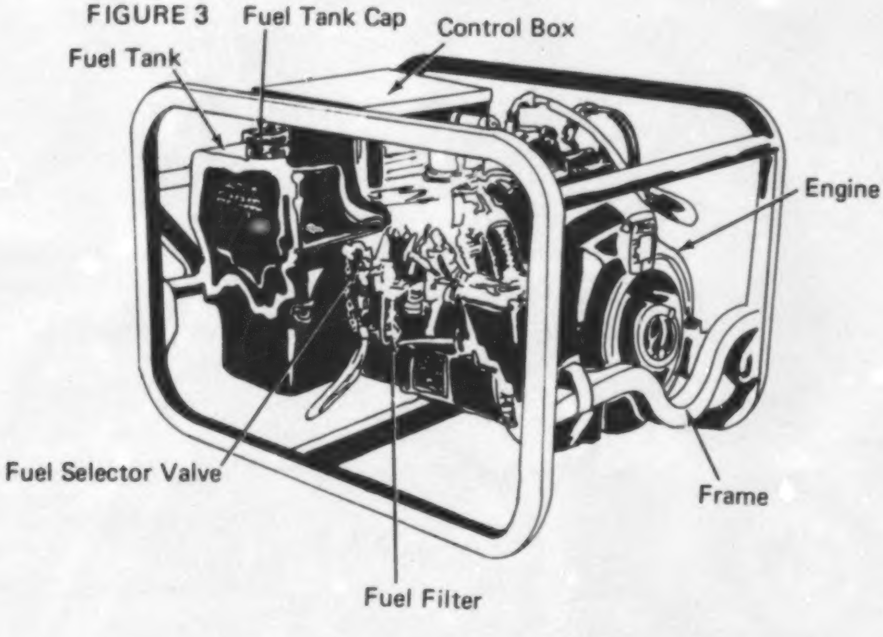
A. Left-rear, three-quarter view

FIGURE 2


On/Off Load Switch
Variable Resistor
Convenience Outlets
Control Box
AC Voltmeter
Frequency Meter
Exhaust Extension
Engine
Load Terminals
Generator
Frame
Ground Terminal

B. Right-front, three-quarter view

FIGURE 3


Fuel Tank Cap
Control Box
Fuel Tank
Engine
Fuel Selector Valve
Frame
Fuel Filter

INFORMATION SHEET

V. Main reasons alternating current is used rather than direct current

  A. Alternating voltage may be raised and lowered in value easily

  B. AC energy may be generated and distributed efficiently at a relatively high voltage, and then reduced to a lower, usable voltage at the load, while direct current voltages are not easily changed in value

  C. DC energy is usually generated at the voltage at which it is to be used

GENERATORS
UNIT V

JOB SHEET #1--PERFORM DAILY INSPECTION ON A GENERATOR

I. Equipment and materials

A. Generator (Figure 4)

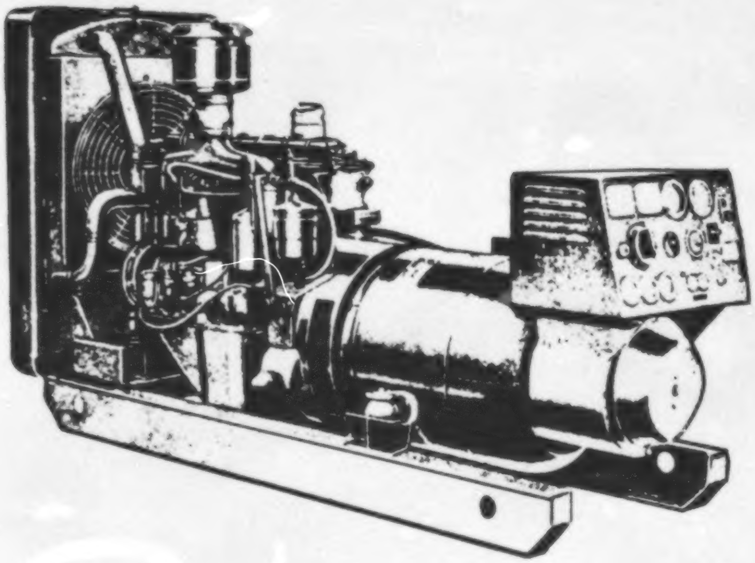
B. Engine coolant

C. Fuel

D. Engine oil

E. Shop rags

FIGURE 4



II. Procedure

A. Walk around unit inspecting for broken, worn, or missing parts, and leaks

B. Check unit for cleanliness

C. Check for proper ground

D. Inspect ground stud threads, shock mounts, and bonding strap

E. Check engine oil level; fill if necessary

JOB SHEET #1

F. Check engine coolant level; fill if necessary

G. Check battery electrolyte level and battery connections; fill if necessary

H. Check fuel level; fill if necessary

I. Check air cleaner; clean if necessary

J. Check condition and adjustment of drive belts; make necessary adjustments

K. Check fuel pump sediment bowl (where applicable)

L. Check exhaust system

M. Inspect for damaged instruments

N. Inspect for loose mountings

O. Check instruments for normal operation

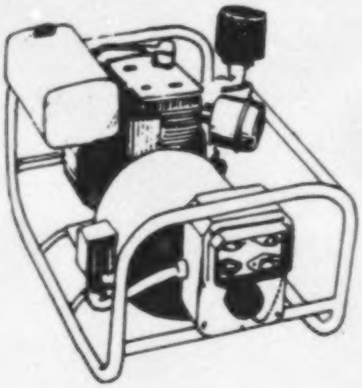
P. Check controls for proper functioning

GENERATORS
UNIT V

JOB SHEET #2--OPERATE A PORTABLE AC GENERATOR

I. Equipment--Portable AC generator (Figure 5)

FIGURE 5



II. Procedure

A. Position arrow on variable resistor knob pointing up

B. Set the load switch in the off position

C. Turn on fuel selector valve

(NOTE: This valve is used to select tank fuel supply or external fuel supply.)

D. Turn the engine off/run switch to run position

E. Rotate the choke lever clockwise to choke engine, if engine is cool

F. Start engine using the starting rope

G. Move choke to off position

(NOTE: Do not overchoke engine.)

H. Gradually move carburetor control to govern; lock in position after engine starts

I. Warm up engine for a few minutes before applying load

(NOTE: Engine should run smoothly at governed speed before applying load.)

JOB SHEET #2

J. Check voltmeter reading

(NOTE: It should read either 120 V or 240 V.)

K. Check frequency meter; normal reading should be 60 cps

L. Flip the load switch on

M. Turn variable resistor knob to set output voltage to proper value (120 or 240 volts)

N. Plug lights and/or accessories into convenience outlets

GENERATORS
UNIT V

TEST

NAME ______________________________ SCORE ______________

1. List five uses of generators.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

   e. ______________________________

2. Match terms associated with generators to their correct definitions. Write the correct numbers in the blanks.

_____a. Mechanically-driven machine used as a prime mover for steam or water turbines and gasoline or diesel engines; delivers electrical energy to electric lights or machines

_____b. Machine that converts either mechanical energy to electrical energy or electrical energy to mechanical energy

_____c. Rotary engine driven by pressure of liquid or gas against its vanes

_____d. Alternating current; electric current that reverses its direction at regular intervals

_____e. Direct current; electric current that flows in one direction and is constant in value

_____f. Cycles per second

_____g. Rotary control used to control output voltage of the generator

_____h. Toggle switch used to connect and disconnect the generator to and from the load

1. Generator
2. Variable resistor
3. AC
4. Turbine
5. DC
6. cps
7. Load switch
8. Dynamo

TEST

_____i. Graduated meter that indicates voltage at load terminals from 0 to 65 cps

_____j. Graduated meter that indicates frequency of the generator from 0 to 65 cps

_____k. Course or series of events or operations that recur regularly

_____l. Movement of electric charges along a conductor; measured by means of a low-resistance ammeter

_____m. Number of complete cycles passed through in one second

_____n. Potential difference expressed in volts; measured by means of a high-resistance voltmeter

9. Frequency meter
10. Current
11. Voltmeter
12. Voltage
13. Cycle
14. Frequency

3. List five types of generators.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

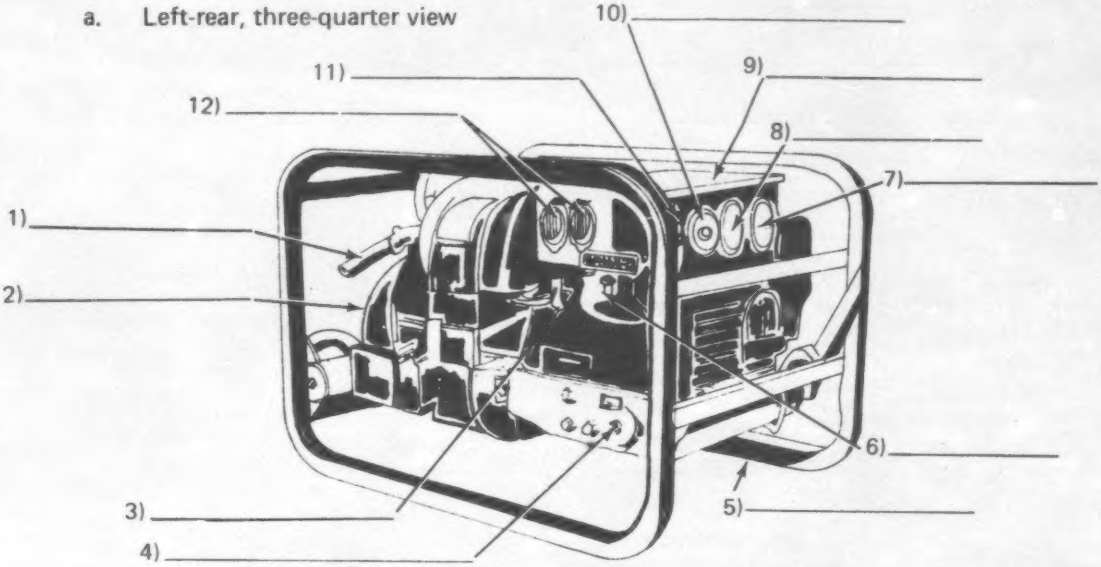
e. ____________________

TEST

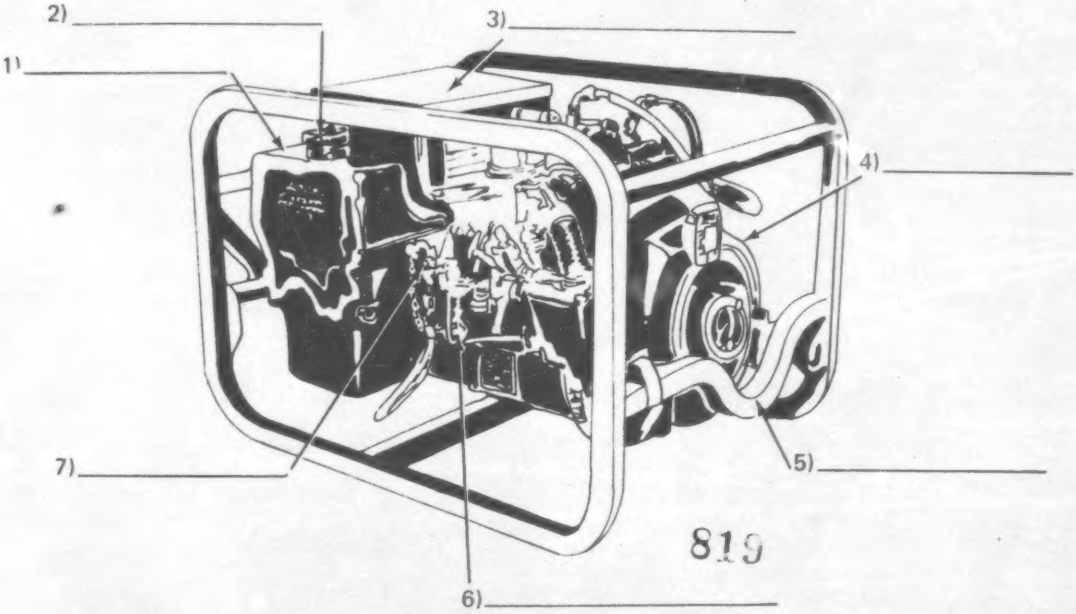
4. Identify basic parts of an AC portable generator. Write the correct names in the blanks. Some answers may be used more than once.

On/off load switch
Frequency meter
Control box
Generator
Fuel selector valve
Load terminals
Variable resistor
Exhaust extension
Fuel tank
Ground terminal
Engine
AC voltmeter
Frame
Fuel filter
Convenience outlets
Fuel tank cap

a. Left-rear, three-quarter view



b. Right-front, three-quarter view



TEST

5. Describe the main reasons alternating current is used rather than direct current.

(NOTE: Test question 6 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

6. Demonstrate the ability to

   a. Perform daily inspection on a generator.

   b. Operate a portable AC generator.

GENERATORS
UNIT V

ANSWERS TO TEST

1. Answer should include any five of the following

   a. Temporary lighting and floodlights

   b. Power source for electric hand tools

   c. Power source for battery chargers and boosters

   d. Power source for hoists and winches

   e. Power source for heavy equipment used in underground work

   f. Power source for welders

2. a. 1

   b. 8

   c. 4

   d. 3

   e. 5

   f. 6

   g. 2

   h. 7

   i. 11

   j. 9

   k. 13

   l. 10

   m. 14

   n. 12

3. Answer should include any five of the following

   a. Portable

   b. Skid-mounted

   c. Two-wheel trailer-mounted

   d. Four-wheel trailer-mounted

   e. Truck-mounted

   f. Welder-mounted

ANSWERS TO TEST

4. a. Left-rear, three-quarter view
    1) Exhaust extension
    2) Engine
    3) Generator
    4) Ground terminal
    5) Frame
    6) Load terminals
    7) Frequency meter
    8) AC voltmeter
    9) Control box
    10) Variable resistor
    11) On/off load switch
    12) Convenience outlets

   b. Right-front, three-quarter view
    1) Fuel tank
    2) Fuel tank cap
    3) Control box
    4) Engine
    5) Frame
    6) Fuel filter
    7) Fuel selector valve

5. Description should include the following
   a. Alternating voltage may be raised and lowered in value easily
   b. AC energy may be generated and distributed efficiently at a relatively high voltage, and then reduced to a lower, usable voltage at the load, while direct current voltages are not easily changed in value
   c. DC energy is usually generated at the voltage at which it is to be used

6. Performance skills evaluated to the satisfaction of the instructor